EXHIBIT C-1:
ARB's METHODOLOGY

SECTION 7.8
ROAD CONSTRUCTION DUST

SECTION 7.8

ROAD CONSTRUCTION DUST

(Updated August 1997)

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Construction and Demolition

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION
630-634-5400-0000 (47381) Road Construction Dust

METHODS AND SOURCES

The road construction dust source category provides estimates of the fugitive dust particulate matter due to construction activities while building roads. The emissions result from site preparation work which may include scraping, grading, loading, digging, compacting, light-duty vehicle travel, and other operations. Particulate matter emissions estimates for road building construction activities are listed in Table 1.

OVERVIEW OF ESTIMATION METHODOLOGY

Dust emissions from road construction operations are computed by using a PM_{10} emission factor developed by Midwest Research Institute during 1996.[1] The emission factor is based on observations of construction operations in California and Las Vegas. Activity data for road construction is expressed in terms of acre-months of construction. Acre-months are based on estimates of the acres disturbed for road construction. The acres disturbed are computed based on: estimates of the difference in road mileage between 1986 and 1987; estimates of road width (to compute acres disturbed); and, an assumption of 18 months as the typical project duration.

EMISSIONS ESTIMATION METHODOLOGY

Emission Factor. The emission factor used for our estimates of geologic dust emissions from road construction activities is based on work performed by Midwest Research Institute (MRI)[1] under contract to the PM_{10} Best Available Control Measure working group. For most parts of the State, the emission factor used is 0.11 tons PM_{10}/acre-month of activity (or 0.17 tons TSP/acre-month). This emission factor is based on MRI's observation of the types, quantity, and duration of operations at eight construction sites (three in Las Vegas, and five in

California). The bulk of the operations observed were site preparation related activities. The observed activity data were then combined with operation specific emission factors provided in U.S. EPA's AP-42 (5th Edition)[2] document to produce site emissions estimates. These site estimates were then combined to produce the overall average emission factor of 0.11. This emission factor is approximately 71% lower than the previous emission factor that was used from the 4th Edition of AP-42.

The construction emission factor is assumed to include the effects of routine dust suppression measures such as watering. A dust control effectiveness of 50% is assumed from these measures, which is based on the estimated control effectiveness of watering.[3] Therefore, if this emission factor is used for road construction activities where watering is not used, it should be doubled to more accurately reflect the actual emissions. The MRI document lists their average emission factor values as uncontrolled. However, our judgement is that the activities do include the effects of controls. All of the test sites were actual operations that used watering controls, even if in some cases they were not used during the actual site visits. Our belief is that the residual effects of controls are reflected in the MRI emission estimates.

The MRI report also includes an emission factor for worst-case construction emissions of 0.42 tons of PM_{10}/acre-month. This emission factor is appropriate for large scale construction operations which involve substantial earthmoving operations. The South Coast Air Quality Management District (SCAQMD) estimated that a percentage of their construction projects involve these types of operations, and applied the larger emission factor to the activities. For the remainder of the State, such detailed information is not readily available, so the average emission factor of 0.11 tons PM_{10}/acre-month was used.

This methodology directly computes PM_{10} emissions. The TSP emissions are PM_{10} x 1.56.[4]

Activity Data. For the purpose of estimating emissions, it is assumed that the fugitive dust emissions are related to the acreage affected by construction. Region-wide estimates of the acreage disturbed by roadway construction are not directly available. Therefore, the miles of road built and the acreage disturbed per mile of construction are used to estimate the overall acreage disturbed.

The miles of road built are based on the difference in the road mileage reported between 1986 and 1987. These data, from the Department of Finance[5] and Caltrans,[6] are split for each county into freeways, state highways, and city and county road, and are summarized in Table 2. The acreage of land disturbed per mile of road construction is based on the number of lanes, lane width, and shoulder width for each listed road type. The assumptions used are provided in Table 3. Because most projects will probably also disturb land outside of the immediate roadway corridor, these acreage estimates are somewhat conservative.

The final parameter needed is project duration, which is assumed to be an average 18 months.[7] Multiplying the road mileage built, the acres per mile, and the months of construction provides the acre-months of activity for road building construction. This, multiplied by the emission factor, provides the emissions. The emissions in Table 1 are based on the 1987 activity data grown to the 1993 inventory year.

TEMPORAL ACTIVITY AND GROWTH

Temporal activity is assumed to occur five days a week between the hours of 8 a.m. and 4 p.m. The table below shows the percentage of construction activity that is estimated to occur during each month. The monthly activity increases during the spring and summer months as shown below. Some districts use a slightly different profile that has a larger peak during the summer months. Construction emissions for future years are based on construction activity projections.

CES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
47381	6.4	6.4	8.3	9.2	9.2	9.2	9.2	9.2	9.2	8.3	8.3	7.3

ASSUMPTIONS AND LIMITATIONS

1. The current methodology assumes that all construction operations in all parts of the State emit the same levels of PM_{10} on a per acre basis.

2. It is assumed that watering techniques are used statewide, reducing emissions by 50% and making it valid to apply the MRI emission factor without correction.

3. The methodology assumes that the acreage disturbed per mile for road building is similar statewide, and the overall disturbed acreage is approximately the same as the finished roadway's footprint.

4. The methodology assumes that construction dust emissions are directly proportional to the number of acres disturbed during construction.

CHANGES IN THE METHODOLOGY

The major change to the methodology is the incorporation of the MRI emission factor for construction, which reduces the PM_{10} emission estimates by over 70%.

COMMENTS AND RECOMMENDATIONS

To improve the road construction dust estimates, both the emission factor and activity data require attention. Possible improvements to the methodology that could be made are: updated estimates of the acreages disturbed by road construction projects and the duration of the projects; gathering of more detailed site data to allow use of the more site-specific emission factors listed in the MRI document;[1] and, probably most needed, the update of activity levels to reflect conditions more recent than 1987 (even if the existing methodology is used). Unfortunately, in most cases these activity data are difficult to derive on a statewide basis.

SAMPLE CALCULATIONS

The instructions and associated table below provide an example of estimating road construction dust emissions for Santa Barbara county.

Step 1: Miles Constructed. For each road type, enter the miles of road constructed during the year. For this example, the values from Table 2 are used.

Step 2: Area per Mile. Using the data in Table 3, enter the estimated acres of land disturbed for each mile of road construction.

Step 3: Compute the Acres Disturbed. Acres disturbed is: *Miles Constructed x Area per Mile.*

Step 4: Project Duration. Enter the average project duration. The ARB default value is 18 months.

Step 5: Compute Acre-Months. Multiply the values from steps 3 and 4 together to get acre-months. *Acre-Months = Acres Disturbed x Months.*

Step 6: Emission Factor. Input the emission factor. The ARB default is 0.11 tons PM_{10}/acre-month when standard watering practices are used.

Step 7: Compute Emissions. Multiply the values from step 5 and step 6 together to get the emissions for each road type. *Acre-Months x Emission Factor = Emissions.* Then, finally, total the emissions to get the overall county-wide PM_{10} emissions.

Estimating PM_{10} Construction Dust In Santa Barbara County

		Road Type			
		Freeway	Highway	City & County	**Totals**
Step 1	Miles Constructed	1.6	14.3	25.4	**41.3**
Step 2	Area per Mile (acres)	12.1	9.2	7.8	
Step 3	Acres Disturbed	19.4	131.6	198.1	**349.0**
Step 4	Project Duration (months)	18	18	18	
Step 5	Acre-Months	348.5	2368.1	3566.2	**6282.7**
Step 6	Emission Factor (tons PM_{10}/acre-month)	0.11	0.11	0.11	
Step 7	**Emissions** (tons PM_{10}/year)	**38.3**	**260.5**	**392.3**	**691.1**

ADDITIONAL CODES

Source Category Growth and Control Codes
Various

Source Category Code Pollutant Speciation Profiles
For All: PM = 391, VOC = not applicable

Source Category Code Reactivity Factors
Not Applicable

REFERENCES

1. Muleski, Greg. Improvement of Specific Emission Factors (BACM Project No. 1), Final Report. Midwest Research Institute, March 29, 1996.

2. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, AP-42, Section 13.2.3, Fifth Edition. January 1995.

3. PEDCo Environmental Specialists. Investigation of Fugitive Dust Sources - Emissions and Control. Prepared for the Environmental Protection Agency, OAQPS. Contract No. 68-02-0044. May 1973.

4. Taback, H.J., et al, Fine Particulate Emissions from Stationary and Miscellaneous Sources in the South Coast Air Basin, Report Number KVB 5806-783, KVB. February 1979.

5. California Department of Finance, 1987 California Statistical Abstract. Financial Research Section, State of California.

6. Data received from Susan Kwong, Highway System Engineering Branch, California Department of Transportation.

7. Midwest Research Institute, Inventory of Agricultural Tilling, Unpaved Roads and Airstrips and Construction Sites. For the U.S. Environmental Protection Agency, PB 238-919, Contract 68-02-1437. November 1974.

UPDATED BY

Patrick Gaffney
August 1997

Table 1. 1993 Road Building PM_{10} Construction Dust.

AB	CO	NAME	Road Construction EIC: 630-634-5400-0000 Process Rate (acre-month/yr)	PM_{10} (tons/yr)
GBV	2	ALPINE	126.2	13.9
	14	INYO	0.0	0.0
	26	MONO	0.0	0.0
LC	17	LAKE	50.3	5.5
LT	9	EL DORADO	120.8	13.3
	31	PLACER	183.3	20.2
MC	3	AMADOR	96.5	10.6
	5	CALAVERAS	79.2	8.7
	9	EL DORADO	635.3	69.9
	22	MARIPOSA	32.0	3.5
	29	NEVADA	3201.3	352.1
	31	PLACER	2953.8	324.9
	32	PLUMAS	667.7	73.4
	46	SIERRA	73.0	8.0
	55	TUOLUMNE	752.3	82.8
NC	8	DEL NORTE	840.2	92.4
	12	HUMBOLDT	543.7	59.8
	23	MENDOCINO	1963.8	216.0
	49	SONOMA	2222.5	244.5
	53	TRINITY	0.0	0.0
NCC	27	MONTEREY	1680.7	184.9
	35	SAN BENITO	647.3	71.2
	44	SANTA CRUZ	3868.2	425.5
NEP	18	LASSEN	30.3	3.3
	25	MODOC	46.3	5.1
	47	SISKIYOU	338.5	37.2
SC	19	LOS ANGELES	49.8	85.7
	30	ORANGE	41.1	70.9
	33	RIVERSIDE	13.6	23.4
	36	SAN BERNARDINO	238.2	410.4
SCC	40	SAN LUIS OBISPO	7467.3	821.4
	42	SANTA BARBARA	7180.8	789.9
	56	VENTURA	5258.2	578.4
SD	37	SAN DIEGO	47745.0	5252.0
SED	13	IMPERIAL	500.5	55.1
	15	KERN	2709.7	298.1
	19	LOS ANGELES	43.7	75.3
	33	RIVERSIDE	10.4	17.9
	36	SAN BERNARDINO	17012.3	1871.4
SF	1	ALAMEDA	1306.7	143.7
	7	CONTRA COSTA	6084.0	669.2
	21	MARIN	304.5	33.5
	28	NAPA	211.8	23.3
	38	SAN FRANCISCO	37.5	4.1
	41	SAN MATEO	3098.7	340.9
	43	SANTA CLARA	2090.3	229.9
	48	SOLANO	1082.2	119.0
	49	SONOMA	1306.8	143.8
SJV	10	FRESNO	6460.5	710.7
	15	KERN	1275.2	140.3
	16	KINGS	1558.0	171.4
	20	MADERA	0.0	0.0
	24	MERCED	1987.2	218.6
	39	SAN JOAQUIN	2753.8	302.9
	50	STANISLAUS	6652.0	731.7
	54	TULARE	2435.2	267.9
SV	4	BUTTE	1085.5	119.4
	6	COLUSA	0.0	0.0
	11	GLENN	32.5	3.6
	31	PLACER	650.2	71.5
	34	SACRAMENTO	6159.0	677.5
	45	SHASTA	1056.2	116.2
	48	SOLANO	1637.7	180.1
	51	SUTTER	366.8	40.3
	52	TEHAMA	77.7	8.5
	57	YOLO	18832.7	2071.6
	58	YUBA	211.7	23.3
		Statewide Total	178178	20239

PM Fraction: $PM_{10} = TSP \times 0.64$ (TSP Emissions = $PM_{10}/0.64$)

Table 2

Miles of New Road Constructed in 1987

Air Basin	County Name	Freeway	Highway	City & County
GBV	ALPINE	0.50	0.00	0.00
	INYO	0.00	0.00	0.00
	MONO	0.00	0.00	0.00
LC	LAKE	0.20	0.00	0.00
LT	EL DORADO	0.00	0.00	0.85
	PLACER	0.00	0.21	1.23
MC	AMADOR	0.00	0.00	0.60
	CALAVERAS	0.00	0.00	0.50
	EL DORADO	0.00	0.00	3.64
	MARIPOSA	0.00	0.00	0.20
	NEVADA	3.30	0.10	13.90
	PLACER	0.00	1.54	9.18
	PLUMAS	0.00	0.00	4.20
	SIERRA	0.00	0.00	0.50
	TUOLUMNE	0.00	0.00	4.60
NC	DEL NORTE	3.40	0.00	0.00
	HUMBOLDT	0.10	0.00	3.30
	MENDOCINO	6.40	0.00	2.10
	SONOMA	0.00	0.00	15.37
	TRINITY	0.00	0.00	0.00
NCC	MONTEREY	3.40	0.90	4.60
	SAN BENITO	0.00	1.60	2.20
	SANTA CRUZ	13.40	0.00	2.40
NEP	LASSEN	0.00	0.00	0.20
	MODOC	0.00	0.00	0.30
	SISKIYOU	0.00	0.00	2.20
SC	LOS ANGELES	0.41	0.00	52.84
	ORANGE	0.20	0.00	145.40
	RIVERSIDE	2.60	0.00	34.48
	SAN BERNARDINO	0.00	0.00	6.76
SCC	SAN LUIS OBISPO	16.40	0.00	19.70
	SANTA BARBARA	1.60	14.30	25.40
	VENTURA	0.00	0.00	43.70
SD	SAN DIEGO	0.50	7.00	310.00
SED	IMPERIAL	0.00	0.10	3.10
	KERN	0.00	0.00	16.93
	LOS ANGELES	0.19	0.00	24.86
	RIVERSIDE	7.40	0.00	98.12
	SAN BERNARDINO	0.00	0.00	105.94
SF	ALAMEDA	0.00	0.20	9.80
	CONTRA COSTA	0.00	0.10	46.30
	MARIN	1.50	0.00	0.00
	NAPA	0.00	0.00	1.60
	SAN FRANCISCO	0.20	0.00	0.00
	SAN MATEO	6.00	0.00	14.70
	SANTA CLARA	0.00	0.60	15.30
	SOLANO	0.00	0.04	8.38
	SONOMA	0.00	0.00	9.83
SJV	FRESNO	2.70	0.10	36.10
	KERN	0.00	0.00	7.97
	KINGS	0.00	0.00	9.80
	MADERA	0.00	0.00	0.00
	MERCED	0.00	0.00	12.00
	SAN JOAQUIN	0.10	0.10	17.00
	STANISLAUS	0.00	0.00	40.90
	TULARE	2.70	0.00	10.20
SV	BUTTE	0.60	0.00	5.80
	COLUSA	0.00	0.00	0.00
	GLENN	0.00	0.00	0.20
	PLACER	0.00	0.55	3.29
	SACRAMENTO	0.00	0.10	39.30
	SHASTA	0.00	0.00	6.50
	SOLANO	0.00	0.06	11.11
	SUTTER	0.00	0.00	2.40
	TEHAMA	0.00	0.00	0.50
	YOLO	0.00	0.00	110.80
	YUBA	0.00	0.00	1.50
TOTAL		73.80	27.60	1380.58

Table 3

Roadway Acres per Mile of Construction Estimates

Road Type	**Freeway**	**Highway**	**City & County**
Number of Lanes	5	5	2
Width per Lane (feet)	12	12	12
Shoulder Width (feet)	10'x4 = 40'	20'x2 = 40'	20'x2 = 40'
Roadway Width* (feet)	100	76	64
Roadway Width* (miles)	0.019	0.014	0.012
Area per Mile** (acres)	12.1	9.2	7.8

*Roadway Width (miles) = [(Lanes x Width per Lane) + Shoulder Width] x (1 mile/5280 feet)

**Area per Mile (acres) = Length x Width
= 1 Mile x Width x 640 acres/mile^2

EXHIBIT C-2:
PM_{10} CONSTRUCTION-RELATED AND UNPAVED ROAD EMISSION ANALYSIS

Prepared by:
Sierra Research

August 9, 2001

Memo To: Huasha Liu, SCAG

From: Robert Dulla, Tom Carlson, and Earl Withycombe, Sierra Research

Subject: Final Analysis of PM_{10} Emissions From Road Construction and Unpaved Road Paving Specified in the 2001 RTP

Summary

Estimates of fugitive dust particulate matter produced by road construction were prepared for those regions in which construction emissions were identified as a significant contributor to PM_{10} air quality in submitted or approved state implementation plans (SIPs). Estimates of PM_{10} emissions were prepared for the following areas:

- South Coast Air Basin (SCAB) area;
- San Bernardino County portion of the Mojave Desert Air Basin (MDAB);[*] and
- Coachella Valley portion of the Salton Sea Air Basin (SSAB).

For the SCAB area, PM_{10} emissions were estimated from road construction only. In the MDAB and SSAB areas, a more refined analysis was performed. For these areas, emission reductions from paving of previously unpaved roads that occur under the RTP were also determined and subtracted from the incremental emissions due to new road construction.[†]

Road Construction - The road construction emission estimates were prepared in accordance with the Section 7.8, Road Construction Dust procedure specified in ARB's Methods for Assessing Area Source Emissions in California. That procedure is designed to estimate emissions that result from soil transport and disturbance that may include scraping, grading, loading, digging, compacting, light-duty vehicle travel, and other operations that occur during road construction.

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[*] Excluding the Searles Valley area.

[†] Based on recent discussions with SCAG staff, it was determined that the on-road PM_{10} emission estimates prepared separately by SCAG as part of the Build vs. No-Build test do not account for emission reductions from paving of unpaved roads that occurs under the RTP in the subject planning areas. As it is currently configured, SCAG's travel model does not distinguish paved and unpaved roads and treats all links in its network as paved roads. Thus, paving of previously unpaved roads occurring under the RTP provides a net emission reduction between the Build and No Build entrained road dust emissions developed separately by SCAG.

The methodology combines PM_{10} emission factors with estimates of activity data for road construction. Estimates of road construction were obtained from changes in road mileage (expressed in both lane and centerline miles) forecast in the RTP for each of the regions noted above. Where appropriate, miles of HOV lane construction were reduced to account for restriping projects that do not produce fugitive dust. The resulting miles of roadway construction were combined with default values of lane and shoulder width specified in the ARB methodology to estimate the acres of land disturbed. These estimates were combined with the default emission rates specified in ARB's methodology to quantify the level of PM_{10} emissions produced each year. The SCAB and SSAB area estimates were also adjusted to take credit for the 10% reduction in PM_{10} construction emissions that the South Coast AQMD estimated would be provided by the Rule 403 amendments in the 1997 AQMP. (The Coachella Valley portion of the SSAB is included in the jurisdictional area covered by Rule 403.) No additional credit was applied to road construction emissions in the Victor Valley portion of the MDAB where the benefits of Rule 403 are not directly applicable.

A summary of the acres of disturbed land and PM_{10} emissions produced by road construction for the conformity milestone years in each region is presented in Tables 1–3. As discussed earlier, the estimates of disturbed acreage were based on centerline and lane-mile road construction activity supplied by SCAG from travel model runs for 2000, 2010, 2020, and 2025 milestone years. Thus, these acreages reflect incremental disturbance between Plan (Build) and Baseline (No Build) construction over the analysis periods shown. The PM_{10} Emissions columns in these tables represent incremental road construction emissions expected to occur in each year of the analysis period shown, assuming construction activity is evenly distributed between milestone years.

The SCAB area estimates are presented in Table 1. It shows that PM_{10} emissions are greatest between 2000 and 2010 when levels are estimated to be 2.90 tons per day. Those values are projected to decline in years beyond 2010. In the San Bernardino County portion of MDAB, Table 3 shows that PM_{10} construction emissions are expected to occur at just over one-half ton per day for each year between 2001 and 2010. From 2011 to 2020, PM_{10} construction emissions are projected to occur at roughly one ton per day and then all but disappear after 2020. In the Coachella Valley portion of SSAB, Table 3 indicates that the PM_{10} emission levels from road construction never exceed 0.066 tons per day in any analysis year and disappear after 2020 since no additional construction is programmed for the Coachella Valley beyond 2020.

Table 1
Summary of Land Disturbed and PM_{10} Emissions from Road Construction in the SCAB Area in the 2001 RTP

Analysis Period	Land Disturbed (acres)	PM_{10} Emissions (tons/day)
2000	-	-
2001-2010	5,945.4	2.90
2011-2020	4,155.6	2.03
2021-2025	734.8	0.72

Table 2 **Summary of Land Disturbed and PM_{10} Emissions from** **Road Construction in the San Bernardino County Portion of the MDAB**		
Analysis Period	Land Disturbed (acres)	PM_{10} Emissions (tons/day)
2000	-	-
2001-2010	984.3	0.534
2011-2020	1,909.8	1.036
2021-2025	88.7	0.096

Table 3 **Summary of Land Disturbed and PM_{10} Emissions from** **Road Construction in the Coachella Valley Portion of the SSAB**		
Analysis Period	Land Disturbed (acres)	PM_{10} Emissions (tons/day)
2000	-	-
2001-2010	120.1	0.059
2011-2020	134.2	0.066
2021-2025	0.0	0.000

Unpaved Road Paving - The road paving emission reduction estimates for the MDAB and SSAB areas were prepared in accordance with Sections 7.9 (Entrained Paved Road Dust) and 7.10 (Road Dust – Unpaved Roads) procedures specified in ARB's Methods for Assessing Area Source Emissions in California. These procedures specify entrained road dust PM_{10} emission factors (in pounds per mile of vehicle travel) for travel on both paved and unpaved road surfaces.

These emission factors were combined with future-year forecasts of annual unpaved road paving activity (road miles and traffic counts) in the MDAB and SSAB analysis areas. The results were used to determine PM_{10} emission reductions associated with unpaved road paving expected to occur under the RTP. The "net" difference between unpaved and paved road dust emission factors was multiplied by the length of affected roadways and daily traffic counts on those roadways to compute the PM_{10} emissions reduction from paving unpaved roads.

As stated earlier, these emission reductions were not accounted for in SCAG's travel model-based projections of on-road PM_{10} emissions under the Baseline or No Build network. The modeling network did not distinguish between unpaved and paved road links and treated all links as paved. Thus, entrained road dust emissions on what are unpaved roads in the Baseline network (but were modeled as paved roads) were underestimated in SCAG's on-road emission projections for the No Build scenario. As a result, the incremental road paving emission reductions computed in this analysis must be added to SCAG's Baseline estimates of regional PM_{10} emissions in both areas.

Tables 4 and 5 summarize the road paving PM_{10} emission reductions calculated for the MDAB and SSAB analysis areas, respectively. In the MDAB, Table 4 shows that incremental PM_{10} reductions from unpaved road paving activity under the RTP are projected to exceed two tons per day in calendar year 2001 and steadily decline over time. The reason for this decline is that the road paving activity forecasts for the MDAB supplied by the Mojave Desert Air Quality Management District (MDAQMD) are based on a fixed percentage reduction in unpaved road miles from year to year. Since the difference in unpaved road miles between successive years (e.g., 2000 and 2001) represents the paving activity for a single year, this fixed percentage reduction-based forecast yields decreasing paved road mile increments over time.

As shown in Table 5, PM_{10} emission reductions from unpaved road paving in the SSAB area are expected to occur at a rate of 0.394 tons/day throughout the 25-year RTP planning horizon based on activity data obtained from the Coachella Valley Association of Governments (CVAG). CVAG supplied paving activity data for calendar year 2000 and indicated that the data were "typical" of annual activity projected well into the future. Subsequent conversations* with CVAG confirmed that the amount of annual unpaved road paving was small compared to the "population" of remaining unpaved road mileage within the jurisdiction. Thus, this annual emissions reduction was extrapolated throughout the 25-year RTP horizon.

Table 4
Entrained Road Dust PM_{10} Emission Reductions from Unpaved Road Paving in the San Bernardino County Portion of the MDAB

Analysis Year	PM_{10} Emission Reductions (tons/day)
2001	2.088
2002	1.918
2003	1.767
2004	1.632
2005	1.510
2006	1.402
2007	1.304
2008	1.217
2009	1.138
2010	1.067
2020	0.639
2025	0.533

Table 5
Entrained Road Dust PM_{10} Emission Reductions from Unpaved Road Paving in the Coachella Valley Portion of the SSAB

Analysis Period	PM_{10} Emission Reductions (tons/day)
2001-2025	0.394

* Personal communication with Allyn Waggle, Deputy Executive Director, Coachella Valley Association of Governments, July 31, 2001.

Road Construction Emissions Methodology

Presented below is a summary of the methodology used to prepare an estimate of PM_{10} emissions from road construction in the three analysis areas. To simplify the discussion, examples are limited to the estimates developed for the MDAB area.

Sierra obtained data from SCAG on miles of roadway by facility type for the years 2000, 2010, 2020, and 2025. The facility types included freeways, principle arterials, minor arterials, major collectors, HOV lanes for three-passenger vehicles, HOV lanes for two-passenger vehicles, and toll roads. Except for HOV lane values, increases in miles of roadway between Build and No Build scenarios in 2010 were assumed to represent new RTP construction between 2000 and 2010. Beyond 2010, the No Build scenario remains unchanged from its 2010 forecast. Thus, new RTP construction beyond 2010 was computed from differences in road miles between successive Build forecasts (e.g., 2010 and 2020). These RTP construction road mile increments were used to prepare estimates of the acres of land disturbed over that period.

For HOV lanes, an evaluation of the FY 2000–01 RTIP revealed that 228.8 miles of new lanes are planned through restriping that will not generate any fugitive dust.* This value was deducted from the mileage otherwise reported for HOV lane construction for 2000–2010. Those HOV projects that involved restriping were restricted to the SCAB analysis area. A listing of these projects is included in Attachment 1.

In the absence of project-specific information, ARB assumptions were used to compute the number of new lane-miles included in the construction of each centerline-mile for each facility type. ARB assumed that a centerline-mile of freeway or toll road constituted five new lane-miles, and that a centerline-mile of arterial or collector construction added three lane-miles of new pavement. HOV lanes were assumed to add only single lane-miles to existing freeway sections. Estimates of single lane-miles associated with the widening of existing links were assumed to equal those in excess of the total number of lane-miles involved in new centerline-mile construction. In other words, if 10 centerline-miles of freeway were constructed between two milestone years, the assumption was made that these represented 50 new lane-miles. If, for the same period, the increase in lane-miles of freeway was shown to be 75, then the total length of single lane widening projects was assumed to be 25 lane-miles (75 lane-miles – [5 lane-miles/centerline-mile x 10 centerline-miles]).

The ARB methodology computes the number of acres disturbed per mile of construction by assuming an average width of disturbed soil per mile of construction for each facility type. For all facility types, paved lanes were assumed to be 12 feet wide. For new freeway and toll road sections, four shoulders of 10-foot width were assumed. For arterials and collectors, two new shoulders of 20-foot width were assumed. For HOV lanes, one 12-foot shoulder was assumed to be constructed. The use of these lane and shoulder widths resulted in assumptions of total disturbed widths of 100 feet per freeway or toll road centerline-mile; 76 feet per arterial or collector centerline-mile; 22 feet per freeway, toll road, or HOV lane-mile; and 32 feet per arterial or collector lane-mile.

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* Regional Transportation Improvement Program, Fiscal Year 2000/01 - 2005/06, Southern California Association of Governments, September 2000.

Over one mile of construction, these disturbed widths resulted in total areas of disturbance of 12.12 acres per freeway or toll road centerline-mile; 9.21 acres per arterial or collector centerline-mile; 2.67 acres per freeway, toll road, or HOV lane-mile; and 3.88 acres per arterial or collector lane-mile.

The assumed disturbed-acre factors were combined with ARB-recommended emission and activity factors to compute uncontrolled PM_{10} emissions. The ARB-recommended emission factor is 0.11 tons of PM_{10} emitted per acre-month of soil disturbance. This emission factor incorporates the benefits of routine dust suppression measures such as watering that have a combined effectiveness of 50%. The ARB assumption with respect to activity is that the duration of soil disturbance for a road construction project is 18 months. Thus, project emissions are calculated by multiplying the PM_{10} emission factor by the acreage disturbed and 18 months of disturbance. To determine annual emissions for road construction, the number of acre-months of soil disturbance occurring between milestone years was calculated and divided by the number of years spanned by the milestones. This average number of acre-months was then multiplied by the ARB-recommended emission factor to determine annual PM_{10} emissions. Average annual daily emissions were calculated by distributing annual PM_{10} emissions over 365 days per year. Note that, under this methodology, the project activity and resulting emission estimates were distributed evenly across the years between SCAG forecast years (i.e., 2000–2010, 2010–2020, and 2020–2025), and that this analysis was prepared only for roadway projects incorporated in the 2001 RTP.

The average annual daily emission levels from road construction were also adjusted to account for the benefits of additional regulation. Subsequent to development of the 1996 ARB-recommended emission factor, South Coast AQMD Rule 403 was amended to increase levels of control applicable to road construction projects. In the 1997 update to the AQMD, the District estimated that these amendments would reduce PM_{10} emissions from construction by 10%.* In this analysis, a 10% control factor was applied to the emission estimates (i.e., those calculated using the 1996 ARB emission factor) to produce emission estimates representative of current levels of control. This 10% control factor was applied to road construction emissions within the SCAB and SSAB areas. (The Coachella Valley portion of the SSAB is included in the jurisdictional area covered by Rule 403.) No additional credit was applied to road construction emissions in the Victor Valley portion of the MDAB area.

In the following example, the calculation details are shown for PM_{10} emissions for one of the SCAG milestone years. These details appear in Tables 6 and 7. Table 6 provides a review of the calculations required to determine the amount of land disturbed by road construction between 2000 and 2010. The data on new construction are based on the change between the 2010 No Build and the 2010 Build networks. As previously discussed, the first step was to convert centerline-miles to lane-miles and contrast them with the reported change in lane miles. Based on the ARB methodology, 47 centerline principal arterial miles are equivalent to 141 lane miles (i.e., 3 x 47). Since this is greater than the estimate of 68 additional† principal arterial lane miles constructed between 2000

* Telephone communication with Julia Lester, South Coast AQMD Planning Division, April 5, 2001.

† Additional miles are defined as the increment between Plan (Build) and Baseline (No Build) forecasts.

Table 6
Example Calculation of Acres Disturbed by Road Construction In the MDAB Area for Years Between 2000 and 2010

Facility	New Construction (Plan minus Baseline)		Acreage Disturbance Factors		Acreage Disturbed (acres)		
	Lane-Miles	Cntrline-Miles	Ac/Lane-mile	Ac/Cntrline-mile	Lane-miles	Cntrline-miles	Total
Freeway	<0.1	<0.0	2.67	12.12	<1	<1	<1
Principle Arterial	68.5	46.6	3.88	9.21	0	429	429
Minor Arterial	99.4	-16.4	3.88	9.21	386	0	386
Major Collector	50.4	10.7	3.88	9.21	71	98	169
HOV 2ppv	0.0	0.0	2.67	NA	0	0	0
HOV 3ppv	0.0	0.0	2.67	NA	0	0	0
Toll	0.0	0.0	2.67	12.12	0	0	0
Total					457	528	984

Table 7
Example Calculation of Daily PM_{10} Emissions From Road Construction In the MDAB Area for Years Between 2000 and 2010

Facility	10-yr Total of Acreage Disturbed	10-Yr Total of Acre-Months of Disturbance	1-Yr Average of Acre-Months of Disturbance	1-Yr Average PM_{10} Emissions	Average Daily PM_{10} Emissions
	Acres	Ac-Months	Ac-Months	Ton/Yr	Ton/Day
Freeway	<1	<1	<1	<0.1	<0.001
Principle Arterial	429	7,725	773	85.0	0.233
Minor Arterial	386	6,941	694	76.3	0.209
Major Collector	169	3,050	305	33.6	0.092
HOV 2ppv	0	0	0	0.0	0.000
HOV 3ppv	0	0	0	0.0	0.000
Toll	0	0	0	0.0	0.000
Total	984	17,718	1,772	194.9	0.534

and 2010, the estimate of centerline miles is the focus of the emissions calculation (i.e., no value of acreage disturbed is reported for lane miles).

Table 7 details the calculations required to translate the estimate of disturbed acreage to daily estimates of PM_{10} emissions. The acreage is first multiplied by 18 to estimate the number of months that the soil is disturbed. It is then divided by 10 to estimate the annual number of acre months of construction experienced between 2000 and 2010. It is then multiplied by 0.11 to estimate the level of PM_{10} emitted per year of construction. The annual estimate of PM_{10} emissions is divided by 365 to produce an estimate of PM_{10} emitted per day. (Though not shown in the Table 7 example for the MDAB area, the annual estimate is further adjusted for the 10% reduction in fugitive dust that the South Coast AQMD estimated for improvements in Rule 403 in the 1997 AQMP for the Coachella Valley construction emissions.)

Additional detail on these calculations is provided in the spreadsheet tables included in Attachments 2-4 for each of the analysis areas.

Using the methodology described above, average annual PM_{10} emissions from road construction were also computed for years between 2011–2020 and 2021–2025. A summary of annual PM_{10} emissions in the MDAB area for each of these analysis periods is presented in Table 8.

Table 8
Summary of PM_{10} Emissions From Road Construction in the MDAB Area

Analysis Period	PM_{10} Emissions (tons/day)
2000-2010	0.534
2011-2020	1.036
2021-2025	0.096

Road Paving Emission Reductions Methodology

The approach used to calculate entrained road dust PM_{10} emission reductions resulting from paving of unpaved roads under the RTP is described in this section. This analysis was performed only for the MDAB and SSAB areas. (It was conservatively assumed that future unpaved road paving activity in the largely urbanized SCAB area would be minimal.)

ARB's Area Source Emissions Inventory Manual* was used to determine entrained road dust emission factors for unpaved and paved road travel. The PM_{10} emission factor recommended by ARB for computing emissions from non-farm unpaved roads is 2.27 pounds (lbs) per vehicle mile traveled (VMT). For travel on paved roads, the emission factor is a function of the silt load in the surrounding soil. Based on the ARB Inventory Manual, PM_{10} road dust emission factors for paved road travel are 0.0035 lbs/VMT and 0.0049 lbs/VMT for the MDAB and SSAB analysis areas, respectively. (These separate factors reflect different silt loadings in each area per ARB guidance.) The difference between the emission factors for unpaved and paved road travel represents the "net" emission factor used to compute PM_{10} emission reductions from travel on paved roads that were previously unpaved. Thus, a net PM_{10} emission factor of 2.2665 lbs/VMT

* Area Source Emission Inventory Manual, California Air Resources Board, December 2000, http://www.arb.ca.gov/emisinv/areasrc/index0.htm.

(2.27 – 0.0035) was used in the MDAB area. The net PM_{10} emission factor applied in the SSAB was 2.2651 lbs/VMT.

These emission factors were combined with forecasts of annual road paving activity in the MDAB and SSAB analysis areas under the RTP that were obtained from MDAQMD* and CVAG,† respectively. The road paving activity data consisted of projected road miles being paved each year and estimated traffic counts (annual average daily traffic, AADT) on each road. These activity data are discussed separately for each analysis area below.

MDAB Area - Road paving activity forecasts by calendar year out to 2025 were supplied by the MDAQMD for the MDAB analysis area. The forecast consisted of unpaved road mile populations from year to year, broken down into several types that included maintained and un-maintained county roads and maintained and un-maintained municipal roads. The forecasts were based on a fixed percentage reduction in unpaved road miles from year to year (percentage reductions varied by road type). The difference in unpaved road miles between successive years (e.g., 2000 and 2001) represents the paving activity for a single year (e.g., 2001).

SSAB Area - Average daily traffic counts per unpaved roadway link slated for surfacing were reported by the CVAG from vehicle count data provided by the County of Riverside. Reductions in PM_{10} emissions will occur in the future as unpaved roads in the Coachella Valley are sealed with either asphalt concrete, chip seal, or chemical stabilizer. Because the emissions benefits of chemical stabilizer are difficult to quantify, only the benefits of asphalt concrete and chip seal were evaluated in this analysis. The lengths of affected roadway links were also provided by CVAG. From these data, a total of 347.7 vehicle-miles of travel (VMT) per day occurred on the roads that received asphalt concrete or chip seal treatment for the first time in 2000. Based on discussions with CVAG, this estimate is assumed to represent a typical level of annual paving activity in future years.

The reduction in PM_{10} emissions from the treatment of unpaved roads in the Coachella Valley is considered to be real and permanent through the planning horizon of the RTP. Discussions with staff of the Riverside County Service Area (CSA) Administrator's Office indicate that the CSAs will increase the inventory of treated roads within the Coachella Valley by about 2 miles per year, and that all of the treated roads will be resurfaced each year – either with a chip seal overlay or a rock dust overlay – to preserve the wearing surface.‡

Table 9 illustrates an example calculation of PM_{10} emission reductions from unpaved road paving for the SSAB area. The Link Length and Avg. Daily Traffic columns represent the road paving activity data received from CVAG for calendar year 2000. These values were multiplied together to determine the vehicle miles traveled (VMT) for

* "MD Unpaved Roads Proj.xls" spreadsheet received via e-mail from Alan DeSalvio, Mojave Desert Air Quality Management District, June 13, 2001.
† Letter from Allyn S. Waggle, Deputy Executive Director of the Coachella Valley Association of Governments to Charles Keynejad, Southern California Association of Governments, July 31, 2001.
‡ Telephone discussion with Debbie Cox, Riverside County Service Area Administrator's Office, July 31, 2001.

Table 9 **Example Calculation of Road Paving PM_{10} Emission Reductions in the SSAB Area**				
Road Link	Link Length (miles)	Avg. Daily Traffic (ADT)	Vehicle-Miles Traveled (VMT)	PM10 Emission Reduction (lbs/day)
Broken Arrow Lane/Sage Brush to Paint Brush	0.18	150	27.0	61.1
Camino Idilio/East of Bubbling Wells Road	0.13	300	39.8	90.1
Sage Brush/Barrel Cactus to Hatchet Cactus	0.17	150	25.6	57.9
Western/North of Dillon	0.10	150	15.1	34.1
Sheridan/North of Dillon	0.50	150	75.0	169.9
Hopper/South of Dillon	0.30	150	45.2	102.3
Happy Valley/North of Dillon	0.50	150	75.0	169.9
Sunny Rock/South of Sunnyrock	0.30	150	45.2	102.3
Total			347.7	787.6

each affected link. As explained earlier, the "net" emission factor represents the difference between entrained road dust emissions on paved and unpaved roads. For the SSAB area, the net emission factor is 2.2651 lbs/VMT. This value was then multiplied by the VMT for each affected link to produce emission reduction estimates shown in the rightmost column in Table 9. The total PM_{10} emission reduction across all affected roads was 787.6 lbs/day (or 0.394 tons/day). As explained earlier, CVAG indicated that this activity represents typical annual paving that could be extrapolated into future years.

Attachments 5 and 6 provide the activity data and detail the unpaved road paving PM_{10} emission reduction calculations for the MDAB and SSAB analysis areas, respectively.

Attachments

Attachment 1 HOV Projects Listed in the FY 2000-01 RTIP That Employ Restriping and Produce No Fugitive Dust Emissions						
Lead Agency	**Project ID**	**Rte #**	**Description**	**No. Miles**	**No. Lanes**	**No. Lane Miles**
Los Angeles County						
Caltrans	LA000358	5	HOV	9.7	2	19.4
Caltrans	LA000357	5	HOV	3.0	2	6.0
Caltrans	LA01344	5	HOV	6.2	2	12.4
Caltrans	LA000359	10	HOV	3.2	2	6.4
Caltrans	LA01342	10	HOV	2.2	2	4.4
Caltrans	LA000548	10	HOV	4.1	2	8.2
Caltrans	LA000543	10	HOV	5.9	2	11.8
Caltrans	LA996137	60	HOV	11.2	2	22.4
Caltrans	11985	405	HOV	4.7	2	9.4
Caltrans	1178A	405	HOV	3.6	2	7.2
Caltrans	LA000549	605	HOV	3.8	2	7.6
Orange County						
Caltrans	1240	91	HOV	5.1	2	10.2
Total						125.4

ATTACHMENT 2

Road Construction Emissions Analysis
MDAB - SB/Victor Valley Portion

Year: 2000	Baseline	
Facility Type	Lane Miles	Cntr. Miles
Freeway	521.3	77.8
Principal Arterial	640.6	205.1
Minor Arterial	1,518.3	572.2
Major Collector	1,863.9	697.3
HOV 2ppv	0.0	0.0
HOV 3 ppv	0.0	0.0
Toll	0.0	0.0
Total	4,544.0	1,552.4

Year: 2010	Plan (Build)		Baseline (No Build)		New Construction		Acreage Disturbed			PM10 Emissions (tpd)
Facility Type	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Total	Uncontrolled
Freeway	521.3	77.8	521.2	77.7	0.0	0.0	0.00	0.12	0.12	0.000
Principal Arterial	709.1	251.7	640.6	205.1	68.5	46.6	0.00	429.19	429.19	0.233
Minor Arterial	1,657.3	558.4	1,557.9	574.8	99.4	-16.4	385.59	0.00	385.59	0.209
Major Collector	1,914.2	708.0	1,863.9	697.3	50.4	10.7	71.06	98.39	169.44	0.092
HOV 2ppv	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000
HOV 3 ppv	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000
Toll	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000
Total	4,801.8	1,595.9	4,583.6	1,555.0	218.3	40.9	456.65	527.70	984.35	0.534

Year: 2020	Plan (Build)		New Construction		Acreage Disturbed			PM10 Emissions (tpd)
Facility Type	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Total	Uncontrolled
Freeway	561.3	87.1	40.0	9.4	0.00	113.58	113.58	0.062
Principal Arterial	801.4	211.4	92.3	-40.3	358.09	0.00	358.09	0.194
Minor Arterial	1,932.6	596.9	275.3	38.5	619.71	354.85	974.56	0.529
Major Collector	2,003.2	711.0	89.0	3.0	310.42	27.54	337.96	0.183
HOV 2ppv	47.1	23.6	47.1	23.6	125.57	0.00	125.57	0.068
HOV 3 ppv	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000
Toll	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000
Total	5,345.6	1,630.0	543.8	34.2	1413.80	495.97	1909.77	1.036

Year: 2025	Plan (Build)		New Construction		Acreage Disturbed			PM10 Emissions (tpd)
Facility Type	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Total	Uncontrolled
Freeway	561.3	87.1	0.0	0.0	0.00	0.00	0.00	0.000
Principal Arterial	801.4	211.4	0.0	0.0	0.00	0.00	0.00	0.000
Minor Arterial	1,955.5	596.9	22.9	0.0	88.67	0.00	88.67	0.096
Major Collector	2,003.2	709.8	-0.1	-1.3	0.00	0.00	0.00	0.000
HOV 2ppv	47.1	23.6	0.0	0.0	0.00	0.00	0.00	0.000
HOV 3 ppv	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000
Toll	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000
Total	5,368.4	1,628.8	22.8	-1.3	88.67	0.00	88.67	0.096

ARB Factors:	Construction Width (ft)		Acreage Exposed (ac)	
	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles
Freeway	22	100	2.67	12.12
Principal Arterial	32	76	3.88	9.21
Minor Arterial	32	76	3.88	9.21
Major Collector	32	76	3.88	9.21
HOV 2ppv	22		2.67	
HOV 3 ppv	22		2.67	
Toll	22	100	2.67	12.12

Notes:

1. Estimates of acreages disturbed were calculated using the ARB *Area Source Emission Inventory Methodology*, Section 7.8, Road Construction Dust, as shown to the right:
2. The calculation of daily emissions assumes that projects will be constructed at any time between milestone years, and that average daily emissions are equal to annual emissions divided by 365.
3. The emission factor used, 0.11 ton PM10 per acre-month of construction activity, derives from the ARB Methodology.
4. For years in which lane or centerline miles declined, emissions were assumed to be zero.
5. Per the ARB Methodology, centerline miles for freeways were assumed to comprise 5 lanes, and all others were assumed to comprise 3 lanes except for HOV lanes. Only those lane miles in excess of centerline-miles x # of lanes were assumed to be constructed as single-lane widening projects.

ATTACHMENT 3

Road Construction Emissions Analysis
SSAB - RIV/Coachella Valley Portion

Year: 2000	Baseline	
Facility Type	Lane Miles	Cntr. Miles
Freeway	495.8	68.2
Principal Arterial	577.2	124.1
Minor Arterial	1,134.6	296.7
Major Collector	707.0	202.6
HOV 2ppv	0.0	0.0
HOV 3 ppv	0.0	0.0
Toll	0.0	0.0
Total	2,914.7	691.7

Year: 2010	Plan (Build)		Baseline (No Build)		New Construction		Acreage Disturbed			PM10 Emissions (tpd)	
Facility Type	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Total	Uncontrolled	Controlled
Freeway	495.8	68.2	495.8	68.2	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Principal Arterial	614.2	131.1	587.0	124.1	27.2	7.0	23.82	64.67	88.48	0.048	0.043
Minor Arterial	1,129.4	290.3	1,139.6	296.7	-10.2	-6.5	0.00	0.00	0.00	0.000	0.000
Major Collector	715.1	202.1	707.0	202.6	8.1	-0.5	31.57	0.00	31.57	0.017	0.015
HOV 2ppv	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000	0.000
HOV 3 ppv	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Toll	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Total	2,954.6	691.7	2,929.4	691.7	25.1	0.0	55.39	64.67	120.06	**0.065**	0.059

Year: 2020	Plan (Build)		New Construction		Acreage Disturbed			PM10 Emissions (tpd)	
Facility Type	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Total	Uncontrolled	Controlled
Freeway	495.8	68.2	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Principal Arterial	589.4	124.1	-24.9	-7.0	0.00	0.00	0.00	0.000	0.000
Minor Arterial	1,163.6	296.7	34.2	6.5	57.17	59.79	116.96	0.063	0.057
Major Collector	718.3	202.6	3.2	0.5	12.33	4.88	17.22	0.009	0.008
HOV 2ppv	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000	0.000
HOV 3 ppv	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Toll	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Total	2,967.1	691.7	12.5	0.0	69.51	64.67	134.18	**0.073**	0.066

Year: 2025	Plan (Build)		New Construction		Acreage Disturbed			PM10 Emissions (tpd)	
Facility Type	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Total	Uncontrolled	Controlled
Freeway	495.8	68.2	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Principal Arterial	589.4	124.1	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Minor Arterial	1,163.6	296.7	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Major Collector	718.3	202.6	0.0	0.0	0.00	0.00	0.00	0.000	0.000
HOV 2ppv	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000	0.000
HOV 3 ppv	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Toll	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.000	0.000
Total	2,967.1	691.7	0.0	0.0	0.00	0.00	0.00	**0.000**	0.000

ARB Factors:	Construction Width (ft)		Acreage Exposed (ac)	
	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles
Freeway	22	100	2.67	12.12
Principal Arterial	32	76	3.88	9.21
Minor Arterial	32	76	3.88	9.21
Major Collector	32	76	3.88	9.21
HOV 2ppv	22		2.67	
HOV 3 ppv	22		2.67	
Toll	22	100	2.67	12.12

Notes:
1. Estimates of acreages disturbed were calculated using the ARB Area Source Emission Inventory Methodology, Section 7.8, Road Construction Dust, as shown to the right:
2. The calculation of daily emissions assumes that projects will be constructed at any time between milestone years, and that average daily emissions are equal to annual emissions divided by 365.
3. The emission factor used, 0.11 ton PM10 per acre-month of construction activity, derives from the ARB Methodology.
4. For years in which lane or centerline miles declined, emissions were assumed to be zero.
5. Per the ARB Methodology, centerline miles for freeways were assumed to comprise 5 lanes, and all others were assumed to comprise 3 lanes except for HOV lanes. Only those lane miles in excess of centerline-miles x # of lanes were assumed to be constructed as single-lane widening projects.
6. Controlled PM10 emissions represent uncontrolled PM10 emissions reduced by the 10% control factor estimated in the 1997 South Coast AQMP for adoption and enforcement of amendments to Rule 403.

ATTACHMENT 4

Airbasin	SCAB								Controlled
	RTP Plan		**New Construction**					PM10	PM10
Year	2000		2000		Acreage Disturbed			Emissions	Emissions
	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles	Total	(ton/day)	(ton/day)
Freeway	7,424	2,061	0	0					
Principal Arterial	12,735	5,832	0	0					
Minor Arterial	13,591	8,077	0	0					
Major Collector	4,074	3,263	0	0					
HOV 2ppv	720	704	0	0					
HOV 3 ppv	20	20	0	0					
Toll	292	137	0	0					
Total	38,856	20,094	0	0					
Year	2010		2010						
	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles					
Freeway	8,009	2,267	585	206	0.00	2496.97	2496.97	1.35	1.22
Principal Arterial	13,199	6,014	464	182	0.00	1676.61	1676.61	0.91	0.82
Minor Arterial	13,680	7,962	89	(115)	345.21	0.00	345.21	0.19	0.17
Major Collector	4,165	3,279	91	16	166.79	147.39	314.18	0.17	0.15
HOV 2ppv	1,058	1,041	213	212	566.93	0.00	566.93	0.31	0.28
HOV 3 ppv	20	20	0	0	0.00	0.00	0.00	0.00	0.00
Toll	405	182	113	45	0.00	545.45	545.45	0.30	0.27
Total	40,536	20,765	1,555	546	1078.93	4866.42	5945.36	3.23	2.90
Year	2020		2020						
	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles					
Freeway	8,267	2,332	258	65	0.00	787.88	787.88	0.43	0.38
Principal Arterial	13,303	5,851	104	(163)	403.39	0.00	403.39	0.22	0.20
Minor Arterial	14,107	8,136	427	174	0.00	1602.91	1602.91	0.87	0.78
Major Collector	4,224	3,282	59	3	193.94	27.64	221.58	0.12	0.11
HOV 2ppv	1,130	1,114	72	73	192.00	0.00	192.00	0.10	0.09
HOV 3 ppv	20	20	0	0	0.00	0.00	0.00	0.00	0.00
Toll	649	185	244	3	911.52	36.36	947.88	0.51	0.46
Total	41,700	20,920	1,164	155	1700.85	2454.79	4155.64	2.25	2.03
Year	2025		2025						
	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles					
Freeway	8,315	2,332	48	0	128.00	0.00	128.00	0.14	0.12
Principal Arterial	13,316	5,857	13	6	0.00	55.27	55.27	0.06	0.05
Minor Arterial	14,131	8,136	24	0	93.09	0.00	93.09	0.10	0.09
Major Collector	4,259	3,282	35	0	135.76	0.00	135.76	0.15	0.13
HOV 2ppv	1,251	1,234	121	120	322.67	0.00	322.67	0.35	0.32
HOV 3 ppv	20	20	0	0	0.00	0.00	0.00	0.00	0.00
Toll	648	185	(1)	0	0.00	0.00	0.00	0.00	0.00
Total	41,940	21,046	240	126	679.52	55.27	734.79	0.80	0.72

ARB Factors:	Construction Width (ft)		Acreage Exposed (ac)	
	Lane Miles	Cntr. Miles	Lane Miles	Cntr. Miles
Freeway	22	100	2.67	12.12
Principal Arterial	32	76	3.88	9.21
Minor Arterial	32	76	3.88	9.21
Major Collector	32	76	3.88	9.21
HOV 2ppv	22		2.67	
HOV 3 ppv	22		2.67	
Toll	22	100	2.67	12.12

Notes:

1. Estimates of acreages disturbed were calculated using the ARB Area Source Emission Inventory Methodology, Section 7.8, Road Construction Dust, as shown to the right:
2. The calculation of daily emissions assumes that projects will be constructed at any time between milestone years, and that average daily emissions are equal to annual emissions divided by 365.
3. The emission factor used, 0.11 ton PM10 per acre-month of construction activity, derives from the ARB Methodology.
4. For years in which lane or centerline miles declined, emissions were assumed to be zero.
5. Per the ARB Methodology, centerline miles for freeways were assumed to comprise 5 lanes, and all others were assumed to comprise 3 lanes except for HOV lanes. Only those lane miles in excess of centerline-miles x # of lanes were assumed to be constructed as single-lane widening projects.
6. Controlled PM10 emissions represent uncontrolled PM10 emissions reduced by the 10% control factor estimated in the 1997 South Coast AQMP for adoption and enforcement of amendments to Rule 403.
7. Review of the 2001 RTP found that 125 miles of 2-passenger-per-vehicle HOV lane construction consisted solely of restriping existing pavement which generates no fugitive dust.

ATTACHMENT 5

PM10 Emission Reductions from Paving of Unpaved Roads
MDAB - SB/Victor Valley Portion

Road Mile Paving by Calendar Year (miles)

Road Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2020	2025
County Maintained	2.52	2.50	2.49	2.48	2.47	2.45	2.44	2.43	2.42	2.40	2.29	2.23
County Unmaintained	3.46	3.46	3.45	3.45	3.44	3.44	3.44	3.43	3.43	3.43	3.39	3.38
Municipal Maintained	16.65	15.09	13.70	12.45	11.34	10.35	9.46	8.66	7.94	7.30	3.45	2.53
Munipical Unmaintained	1.83	1.81	1.79	1.77	1.75	1.74	1.72	1.70	1.69	1.67	1.51	1.44

ARB Statewide Default PM10 Entrained Road Dust Emission Factors

Unpaved Roads:	2.27 lbs/VMT
Paved Roads:	0.0035 lbs/VMT
"Net" Emission Factor:	2.2665 lbs/VMT

Road Type	Avg Daily VMT by Road Type (VMT/mi/day)
County Maintained	95
County Unmaintained	1
Municipal Maintained	95
Munipical Unmaintained	10

PM10 Emission Reductions Resulting from Road Paving by Calendar Year (tpd)

Road Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2020	2025
County Maintained	0.271	0.269	0.268	0.267	0.265	0.264	0.263	0.261	0.260	0.259	0.246	0.240
County Unmaintained	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Municipal Maintained	1.792	1.624	1.475	1.341	1.221	1.114	1.018	0.932	0.855	0.786	0.372	0.273
Munipical Unmaintained	0.021	0.020	0.020	0.020	0.020	0.020	0.019	0.019	0.019	0.019	0.017	0.016
TOTALS	**2.088**	**1.918**	**1.767**	**1.632**	**1.510**	**1.402**	**1.304**	**1.217**	**1.138**	**1.067**	**0.639**	**0.533**

PM10 Emission Reductions from Paving of Unpaved Roads
SSAB-RIV/Coachella Valley Portion

Road	(feet)	(mile)	ADT	VMT (veh-mi/day)	Emission Reduction (lb/day)
Broken Arrow Lane/Sage Brush to Paint Brush	950	0.18	150	27.0	61.1
Camino Idilio/east of Bubbling Wells Road	700	0.13	300	39.8	90.1
Sage Brush/Barrel Cactus to Hatchet Cactus	900	0.17	150	25.6	57.9
Western/north of Dillon	530	0.10	150	15.1	34.1
Sheridan/north of Dillon	2640	0.50	150	75.0	169.9
Hopper/south of Dillon	1590	0.30	150	45.2	102.3
Happy Valley/north of Dillon	2640	0.50	150	75.0	169.9
Sunny Rock/south of Sunnyrock	1590	0.30	150	45.2	102.3
			Total	347.7	787.6 lb/day
					0.394 ton/day

Unpaved Road PM Emission Factor = 2.27 lb/VMT
Paved Road PM Emission Factor = 0.0049 lb/VMT

Emission Reduction from Paving = 2.2651 lb/VMT

San Bernardino Associated Governments

San Bernardino County Transportation Commission
San Bernardino County Transportation Authority
San Bernardino County Congestion Management Agency
Service Authority for Freeway Emergencies

472 North Arrowhead Avenue, San Bernardino, California 92401-1421
(909) 884-8276 FAX: (909) 885-4407

July 19, 2001

Mr. Charles Keynejad
Southern California Association of Governments
818 W. 7th Street, 12th Floor
Los Angeles, California 90017

Dear Mr. Keynejad:

At your request, we are documenting the discussion between SANBAG and SCAG in early June regarding paving of unpaved roads with local funds.

The Regional Transportation Improvement Program (RTIP) includes several projects to pave unpaved roads, shown below, to be funded with CMAQ dollars. The CMP network also includes unpaved roads, one of which is State Route 173. All generally have ADTs less than 5,000. With the exceptions of the state highway, paving of these roads is expected to be funded with local dollars.

<u>Unpaved Road Projects in RTIP:</u>
200007 – Adelanto: El Mirage from West City Limits to SR395
200010 – Adelanto: Aster Rd. from Violet to Crippen
200011 – Adelanto: Adelanto Rd. from Crippen to Colusa
200052 – San Bernardino Co.: On Larrea Rd. from 300' South of Quail Bush to SR247
200053 – San Bernardino Co.: On Mesquite St. from Escondido Ave. to Maple Ave.
200107 – Yucca Valley: on Hillcrest Dr. from SR247 – Paisano Ln.
200108 – Yucca Valley: on Fox Trail from Navajo Rd. to .44 miles South
200112 – Adelanto: on Adelanto Rd. from Chapparal to Auburn Avenue
200151 – Adelanto: on El Mirage Rd. from Richardson Rd. to SR395

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Unpaved Road Projects in 1999 CMP:
SR 173
Sheep Creek Rd. – approximately 7.18 miles (located in Adelanto and Hinkley areas)
El Mirage Rd. – approximately .13 miles (located in Stoddard Wells area)
Palmdale Rd. – approximately .25 miles (located in Phelan area)

Reducing the unpaved roads in the area is consistent with the Mojave District Air District strategies.

Should you have any questions concerning this issue or information provided, please call me at (909) 884-8276, ext. 150.

Sincerely,

Lisa E. Poe
Senior Programming Analyst

O:SCAGPM10010719-lep.doc

From: Alan DeSalvio <ADeSalvio@mdaqmd.ca.gov>
To: "'keynejad@scag.ca.gov'" <keynejad@scag.ca.gov>
Date: 6/21/01 8:23AM
Subject: Unpaved Roads in the MDAQMD

It is the MDAQMD's understanding that new development within the District is constructed with paved roads only. Municipalities within the District have led the District to this understanding, and all parties to the MDPA Plan agreed to this as an element of the growth forecast in that plan (i.e., no new unpaved roads). This results in an unpaved road activity forecast of a constant downward trend, with less travel in terms of trips and VMT on unpaved roads each year through the planning horizon (in effect this travel is shifted to paved roads). Note that the forecast will never reach zero, as some unapved roads are simply too isolated to feasibly pave, but the trend remains downward through 2025.

The only possible exceptions would be extremely low density isolated homes in the County area (which will generate negligible trips and vmt). The District does not have a rule requiring that new development be accessible via paved access, but the District has successfully fought (through CEQA) the few County projects that have proposed new unpaved access.

Alan De Salvio

July 31, 2001

Charles Keynejad
Senior Transportation Analyst
Southern California Association of Governments
818 West Seventh Street, 12th Floor
Los Angeles, CA 90017-3435

Subject: Projects Improving Unpaved Roads

Dear Charles:

With assistance from Riverside County staff we are now informed of road improvement projects which genuinely treated unpaved road surfaces to reduce PM 10 emissions. All of the roads identified were completed this past year, and, I am told, fairly represent a typical annual effort. Therefore, I believe you can project this level of future unpaved road surface treatment as a *minimum*. I have identified the roads, their length and the type of treatment. All of these are minor, two lane roads. The Average Daily Traffic for these roads is based on identified land use, the number of lots served and trips generated.

ROAD DESCRIPTION	LENGTH	ADT
The surface treatment for the following roads is asphalt concrete pavement over compacted native soil.		
Broken Arrow Lane/ Sage Brush to Paint Brush	950'	150
Camino Idilio/ east of Bubbling Wells Road	700'	300
The surface treatment for the following roads is a double layer of graded rock chips with asphalt binder, spread and compacted over compacted native soil.		
Sage Brush/ Barrel Cactus to Hatchet Cactus	900'	150
The surface treatment for the following roads is a layer of ground, recycled asphalt pavement with binder, spread and compacted over compacted native soil, then sprayed with asphalt sealant.		
Western/ north of Dillon	530'	150
Sheridan/ north of Dillon	2640'	150
Hopper/ south of Dillon	1590'	150
Happy Valley/ north of Dillon	2640'	150
Sunny Rock/ south of Sunnyrock	1590'	150

COACHELLA VALLEY ASSOCIATION of GOVERNMENTS

The surface treatment for the following roads is a graded layer of rock dust, watered, spread and compacted over compacted native soil, then sprayed with liquid calcium chloride dust suppressant.

Sage Brush/ Round Up to El Serape	1800'	300
El Serape/ Bubbling Wells to Paint Brush	1150'	300
Yaqui/ Sage Brush to Paint Brush	950'	150
Round Up/ Sage Brush to Paint Brush	950'	150
Morley/ Dillon to the storm channel	1000'	150
Laskey/ Kris to Driscoll	570'	150
Driscoll/ Laskey north to house in R/W	660'	150
Catlin Lane/ Kris to Driscoll	400'	150
Sky Ridge/ 22nd Ave. to El Coyote	3960'	150
Lamel/ Dillon south to trees	3680'	150
Terry/ Dillon south to fence	330'	150
20th Ave./ Kris to Skyridge	9580'	750
Ford/ 19th Ave. To 20th Ave.	1300'	300
18th Ave./ Wide Canyon to east end	2500'	750
Channel Run/ Terry west to pavement	5280'	300

The surface treatment for the following roads is spray applied liquid calcium chloride dust suppressant over compacted native soil.

Tamyram Rd./ Dillon south to 24th Ave.	5400'	300
Gemini/ Dillon to Skyline	3680'	150
Berry/ 22nd Ave. south to end	5280'	150

I hope this information will be sufficient for you to proceed with the Coachella Valley air quality conformity analysis. Should you require anything further , please contact me or Aurora Kerr, Director of Human and Community Resources.

Very truly yours,

Allyn S. Waggle
Deputy Executive Director

xc: Julia C. Lester, SCAQMD
Shirley Medina, RCTC
Corky Larson, Executive Director
Aurora Kerr, Director, H&CR

Riverside County
Transportation Commission

3560 University Avenue Suite 100 • Riverside, California 92501
phone: (909)787-7141 • fax: (909)787-7920 • www.rctc.org

July 31, 2001

Mr. Charles Keynejad
Senior Transportation Analyst
Southern California Association of Governments
818 West Seventh Street, 12th Floor
Los Angeles, California 90017-3435

Subject: PM10 – Salton Sea Air Basin

Dear Charles:

This letter is to clarify the use of Measure A funds for road improvement projects. The Riverside County Transportation Commission disburses a portion of the Measure "A" revenues, the voter approved half-cent sales tax for transportation improvements, to each jurisdiction on an annual basis. The County of Riverside received $8,111,724 from Measure "A" for fiscal year ending June 30, 2001. The County allocates these funds for various road improvement projects in both the South Coast Air Basin and Salton Sea Air Basin.

The local sales tax (Measure A) is a component of SCAG's 2001 RTP revenue source as reflected in the 2001 RTP, Appendix F (Finance).

If you need any further information on this matter, you may contact me at (909) 787-7141.

Sincerely,

Shirley Medina

Shirley Medina
Program Manager

Cc: Allyn Waggle, CVAG
George Johnson, County of Riverside

Riverside County
Transportation Commission

3560 University Avenue Suite 100 • Riverside, California 92501
phone: (909)787-7141 • fax: (909)787-7920 • www.rctc.org

July 19, 2001

Mr. Charles Keynejad
Senior Planner
Southern California Association of Governments
818 West Seventh Street, 12th Floor
Los Angeles, California 90017

Subject: Unpaved Roads in Coachella Valley

Dear Charles:

This letter is for the purpose of memorializing our conversation in June regarding unpaved road projects in the 2000 Regional Transportation Plan (RTP). In the Coachella Valley, the Coachella Valley Association of Governments (CVAG) has developed a PM10 Program of projects specifically to reduce PM10 in the Coachella Valley/Salton Sea Air Basin. The program consists of the following project categories: Post Event- Clean-Up, Chemical Stabilization, Paving, and Windbreaks.

The following paving project is currently planned for implementation and is included in the 2001 RTIP:

1. Two streets totaling approximately 1.5 miles in the City of Rancho Mirage which were previously stabilized will be paved in the next year at a cost of approximately $60,000 from local city funds.

In addition, CVAG will be programming approximately $12 million in Congestion Mitigation and Air Quality (CMAQ) funds in the 2001 Regional Transportation Improvement Program (RTIP). The funds will be programmed in fiscal years 2001/02 through 2002/03 for the continuation of the PM10 program consisting of the above project categories. These projects have been determined by the South Coast Air Quality Management District (SCAQMD) as beneficial and crucial in reducing PM10 in the Coachella Valley and it is the intent of RCTC and CVAG to reduce unpaved roads in the Coachella Valley.

If you have any further questions, you may contact me at (909) 787-7141 or email at smedina@rctc.org.

Sincerely,

Shirley Medina

Shirley Medina, Program Manager

Cc: Aurora Kerr, CVAG
Julia Lester, SCAQMD

South Coast
Air Quality Management District
21865 E. Copley Drive, Diamond Bar, CA 91765-4182
(909) 396-2000 · http://www.aqmd.gov

July 19, 2001

Mr. Charles Keynejad
Senior Planner
Southern California Association of Governments
818 W. 7th Street, 12th Floor
Los Angeles, CA 90017

Dear Mr. ~~Keynejad~~ Charles:

SCAG Request for Information Regarding Unpaved Roads in the Coachella Valley

As provided in the 1996 Coachella Valley PM10 Attainment Redesignation Request and Maintenance Plan, there is no growth in entrained unpaved road emissions after 1995. Since the early 1990s, Coachella Valley governments have paved or treated unpaved roads, and there are plans to pave or treat other unpaved roads, depending on CMAQ funding approval. Local ordinances require the paving or stabilizing of any unpaved road with greater than 150 ADT. Our conclusion is that entrained emissions from unpaved roads will likely decline in the future, or at worst, remain the same.

I hope that this information will be helpful in answering questions concerning SCAG's transportation conformity analysis. If you have any further questions regarding this information, please contact Dr. Julia Lester, Program Supervisor – PM10 Strategies Section, at (909) 396-3162.

Sincerely,

Henry Hogo

Henry Hogo
Assistant Deputy Executive Officer
Office of Planning, Rules, and Area Sources

JCL

cc: Elaine Chang
Eyvonne Sells

EXHIBIT D:

TCM1 CATEGORIES EXEMPT FROM THE 1997 OZONE SIP/AQMD (SCAB)

Enforceable Commitments

Measures in and implemented as part of an air plan must be enforceable, quantifiable, accountable and replicable. Because many of the transportation measures do not fit the traditional regulatory framework, appropriate market means of meeting the enforceability criteria are identified for the measures in the Plan.

In Table 2, the appropriate means of ensuring enforceability for each of the transportation strategy's measures is summarized: Public Funding, Private Funding, Public Approval or State Law. Public funding, such as the funds programmed through the Regional Transportation Improvement process, is the mechanism through which transportation infrastructure, projects and programs are funded. Private funding which contributes to the creation or acceleration of markets is also an important component in ensuring that implementation actions occur. This is exemplified by market means of enforceability embodied in Memoranda of Understanding such as those negotiated between the Air Resources Board and vehicle manufacturers to bring zero-emission vehicles and their equivalents to market provide a means of ensuring implementation actions. Although other technologies may necessitate refinements in institutional mechanisms to assess market predictability, the fundamental components already exist. Marketing studies such as those performed for rideshare programs by Chico State, surveys and other statistical data track market trends. In addition, the Southern California Economic Partnership has served as a valuable forum for private and public partners to assess market trends. Review or oversight panels such as the Mobile Source Review Committee have also served an important role in helping link market trends, funding and private and public sector expectations.

Public approvals like those which occur through the Public Utilities Commission and local agencies have long provided surety in the on-going operations of telecommunications firms, utilities and transportation franchises such as taxicabs. Deployment plans for other technologies could provide similar benchmarks to guarantee implementation occurs. Finally, state law like the zero emission vehicle mandate helps establish targets and assurances that implementation actions will take place. Further detail on specific enforceability mechanisms is provided in the discussion of the specific measures.

Each subsequent transportation plan and Regional Transportation Improvement Plan (RTIP) provide increased implementation definition for the region's transportation system. Thus, a further details and action plans for the implementation of the transportation strategy will be incorporated into the Regional Transportation Plan scheduled for adoption in June 1997.

Monitoring System

Federal law requires that funding priority be given to Transportation Control Measures in developing the transportation improvement program. The region's long-range transportation blueprint, Regional Transportation Plan (RTP), and the shorter-term programming needed to fund the improvements, the Regional Transportation Improvement Plan (RTIP) form the cornerstone for improving transportation. Assessing consistency of the emission reductions associated with the RTP/RTIP mobility based strategies--with the appropriate mobile source emission budget contained in the applicable SIP or submitted emissions budgets -- serves as the basis for determining reasonable further progress and timely implementation of this TCM. The RTP's and RTIP's federally funded projects and programs will be the basis for an enforceable commitment for this TCM. Therefore, the timely implementation of TCM-01 report will continue to serve as one of the methods of monitoring transportation improvement impacts on air quality. In addition, based on the methodology developed by Caltrans and currently in use by all rideshare agencies throughout the state, an annual survey to assess changes in travel behavior will be conducted.

Emission Reductions

An estimate of the percentage of emissions reduced by each of the measures contained in the transportation strategy are included in Table 3 for illustrative purposes. When crediting the emissions reductions associated with these measures in the AQMP, however, the emissions reductions are "bundled" with the RME to account for synergy between the measures and eliminates potential overlapping emissions.

TCM-01 TRANSPORTATION IMPROVEMENTS

This measure updates TCM-0 1 in the 1994 AQMP. TCM-01 includes three categories of transportation improvement: high occupancy vehicle improvements, transit/system management and information services. Not included in this measure are transportation projects and programs which are exclusively funded through local funds which are not included in the RTIP. The enforceable commitment for this measure is to fund and implement the first two years of the seven year Regional Transportation Implementation Plan (RTIP). The remaining five years of the RTIP delineates the expectations in project scope and design for the remaining period of the RTIP. Between the end of the RTIP and the year 2010, the Regional Transportation Plan (for this AQMP, the 1994 Regional Mobility Element) provides the foundation for the programs and projects expected to be in place by that date and for which funding was anticipated to be made available through the RTIP process. During this latter timeframe, although the specific mix of projects to be funded with RTIP dollars may ultimately change, the emission reductions anticipated from these projects set a key benchmark in determining the transportation contribution to a mobile source emission budget and associated conformity.

High Occupancy Vehicle (HOV) Improvements

Capital improvements which reduce emissions include: HOV projects, and their pricing alternatives; and park and ride lots/intermodal facilities.

Transit/System Management

Managing the system as follows also improves both congestion and reduces emissions: bus, rail and shuttle transit improvements; bicycle and pedestrian facilities; Urban Freeway System Management improvements; Smart Corridors System Management programs; railroad consolidation programs such as the Alameda Corridor; Congestion Management Plan-based demand management strategies; county/corridor-wide vanpool programs; telecommunication facilities/satellite work centers; seed money for transportation management associations; and TDM demonstration programs/projects eligible for programming in the RTIP.

Information Services

By targeting individuals who travel to and from employment sites and other activity centers (e.g., airports, schools, shopping centers and special event centers) and providing them with information specifically tailored to facilitate use of alternate travel modes, vehicle travel and the associated emissions can be significantly reduced. Providing information services offers an innovative way of reducing vehicle emissions when combined with facility improvements, service enhancements, product development, extensive education, marketing, and promotion.

Potential actions to reduce congestion and emissions through individual efforts include: promoting multi-modal strategies to maximize all options available to commuters; targeting peak period trips for reduction; marketing and promoting the use of HOV lanes to the general public; marketing and promoting rail lines to the general public; educating the public regarding cost, locations, accessibility and services available at park and ride lots; promote and market vanpool formation and incentive programs; promoting ridematching through the Internet and other means of making alternative travel option information more accessible to the general public.

Enforceable Commitment

The first two years of constrained projects in the RTIP will be used as the enforceable commitment. As the biennial element of the RTIP is revised, the list of constrained projects will be updated. The list of constrained projects will "roll forward" and the enforceable commitment will automatically be revised to encompass the first 2 years of the constrained projects contained in each new RTIP. In projecting the long-term (2005, 2010, 2020) impacts which could be ascribed to this measure in the Plan, however, the facilities proposed to be built in the long-term timeframe and programs as they exist today serve as the basis for modeling travel and emission impacts.

Advanced Transportation Technologies

Advanced transportation technologies hold great promise to both decrease congestion and improve air quality. Accelerating the deployment of the following five technologies are considered to offer the largest return on investment: telecommunications; smart shuttle transit; zero emission vehicles; alternative fuel vehicles; and intelligent transportation systems.

Southern California Economic Partnership

In 1994, the Southern California Association of Governments and the South Coast Air Quality Management District created the Southern California Economic Partnership (the Partnership.) As a non-profit organization, the Partnership was established with the specific mission of developing deployment plans for each of the technologies and accelerating the implementation of the advanced technologies throughout the region. Composed of both public and private sector partners, the Partnership provides an important forum for collaboration on technology deployment activities. Continued alliances between the private and public sectors will be necessary to fully implement the action plan for technology deployment.

The Partnership, through its public/private participatory structure is uniquely capable of providing networking and guidance to those parties interested in the deployment of advanced transportation technologies throughout Southern California. Stakeholder "cluster group" meetings on each technology are held on a regular basis, usually at the SCAG or AQMD offices, to discuss implementation barriers and assist in the deployment and marketing strategies. It has in effect become a clearinghouse of ATT information and progress.

To aid Southern California Cities and counties in ATT deployment, The Partnership has developed "Model City Starter Kits" for each of the technologies. These books provide

TABLE 2

Implementation Actions and Agencies

MEASURE		IMPLEMENTATION ACTION(S)	IMPLEMENTING AGENCY
TCM-01 Transportation Improvements	HOV Lanes	Through RTIP, program and implement HOV projects (& pricing alternatives), park & ride lots/intermodal facilities	SCAG, CTCs, Caltrans
	Transit/ Systems Management	Through RTIP, program and implement) transit improvements, Urban Freeway System Management Improvements, smart corridors TSM programs, railroad consolidation programs, CMP-based demand management strategies, vanpool programs, telecommunications facilities, demonstration programs, and bicycle and pedestrian facilities.	SCAG, CTCs, Caltrans, Transit Operators, Local Governments
	Information Services	Through RTIP, program and implement marketing information services for employers and activity centers to encourage shared rides and transit use, and transit pass centers.	SCAG
ATT-01 Telecommunications		Increase usage of telecommunications products and services in daily business, educational and personal activities. Targets 6.8% decrease from 1990 levels in 2010 H-W trip equivalents.	SCAG/SCAQMD/ Partnership/Local Gov'ts/ Subregions
ATT-02 Advanced Shuttle Transit		Introduction of technology-enhanced "smart" vehicles to provide consumers a choice between automobiles and "smart shuttles". In combination w/ "traditional transit", targets a 10% mode split.	SCAG/SCAQMD/ Partnership/Local Gov'ts/ Subregions
ATT-03 Zero-Emission Vehicles/Infrastructure		Enhance market penetration of zero-emission vehicles and aggressive deployment of infrastructure. Facilitate State ZEV mandate and market-enhanced levels of vehicle sales.	SCAG/SCAQMD/ Partnership/Local Gov'ts/ Subregions
ATT-04 Alternative Fuel Vehicles/Infrastructure		Enhance market penetration of alternative fuel vehicles along with aggressive deployment of refueling infrastructure. Facilitate state program actions and market-enhanced levels of vehicle sales.	SCAG/SCAQMD/ Partnership/Local Gov'ts/ Subregions
ATT-05 Intelligent Transportation Systems		Apply Advanced Traffic Management and Advanced Traveler Information Systems to reduce fuel usage and emissions, improve travel time and safety, and support transit-user information and patronage. Facilitate 5% improvement in roadway vehicle capacity.	SCAG/SCAQMD/ Partnership/Local Gov'ts./Subregions
FSS-02 Market Based Transportation Pricing		Further Study. Implement pricing policies to reduce congestion and emissions from vehicles.	State and/or Local Agencies

IV-B-1-3

TABLE 3

Enforceable Mechanisms, Emission Reductions and Monitoring Systems

MEASURE		ENFORCEABLE MECHANISM			EMISSIONS REDUCTIONS*		MONITORING SYSTEM
		Public Funding	Public Approval	State Law	% VOC	% NOx	
TCM-01 Transportation Improvements	HOV Lanes	✓			19%	19%	Timely implementation (for conformity); funding priority given to TCMs by Transportation Commissions/SCAG.
	Transit/ System Management	✓			16%	18%	Timely implementation (for conformity); funding priority given to TCMs by Transportation Commissions/SCAG/Local Governments.
	Information Services	✓			10%	13%	Statistically significant random sample
ATT-01 Telecommunications		✓	✓				action minutes; telecom. Product sales; deployment plans.
ATT-02 Advanced Shuttle Transit		✓	✓		17%	13%	SCAG, SCAQMD, Partnership and Cluster action minutes; adoption of design and safety requirements for support infrastructure and operations; deployment plans.
ATT-03 Zero-Emission Vehicles/Infrastructure		✓	✓		—	—	SCAG, SCAQMD, Partnership and Cluster action minutes; adoption of policies, resolutions, ordinances, building and safety codes, and streamlined permitting requirements for support infrastructure design. Fleet conversion to ZEVs; public charging infrastructure; deployment plans.
ATT-04 Alternative Fuel Vehicles/Infrastructure		✓	✓		—	—	SCAG, SCAQMD, Partnership and Cluster action minutes; adoption of streamlined permitting requirements for support infrastructure; AFV fleet conversion.
ATT-05 Intelligent Transportation Systems**		✓	✓		19%	16%	SCAG, SCAQMD, Partnership and Cluster action minutes; RTIP Expenditures.
FSS-02 Market Based Transportation Pricing					—	—	Further Study.

**Based on the strategy contained in the 1994 Regional Mobility Element and included in the 1997 AQMP as part of the RME. Percentage contributions of each measure to the overall emission reductions are based on EMFAC 7F. These numbers will be updated using EMFAC 7G when the most recent version is provided to SCAG by the District.*

*** Emission reductions from both public sector and private sector actions to implement ITS technologies are identified under ATT-05 because it is impossible to separate analytically the benefits of the two ITS components separately. Public sector actions and commitments through the RTIP are identified under TCM01 and primarily supportive private sector activities are noted under ATT-05.*

EXHIBIT E:

Section 108 of CAA (Listing)

CAA Section 108(f)(1)(A), 42 U.S.C. §7408(f)(1)
Transportation Control Measures

(i) programs for improved public transit;

(ii) restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or high-occupancy vehicles (HOV);

(iii) employer-based transportation management plans, including incentives;

(iv) trip-reduction ordinances;

(v) traffic flow improvement programs that achieve emissions reductions;

(vi) fringe and transportation corridor parking facilities serving multiple-occupancy vehicle programs or transit service;

(vii) programs to limit or restrict vehicle use in downtown areas or other areas of emission concentration particularly during periods of peak use;

(viii) programs for the provision of all forms of high-occupancy, shared-ride services;

(ix) programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place;

(x) programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas;

(xi) programs to control extended idling of vehicles;

(xii) reducing emissions from extreme cold-start conditions;

(xiii) employer-sponsored programs to permit flexible work schedules;

(xiv) programs and ordinances to facilitate non-automobile travel, provision and utilization of mass transit, and to generally reduce the need for single-occupant vehicle travel, as part of transportation planning and development efforts of a locality, including programs and ordinances applicable to new shopping centers, special events, and other centers of vehicle activity;

(xv) programs for new construction and major reconstruction of paths, tracks, or areas solely for use by pedestrian or other non-motorized means of transportation when economically feasible and in the public interest. For purposes of this clause, the Administrator shall also consult with the Secretary of the Interior;

(xvi) programs to encourage removal of pre-1980 vehicles*.

*NOTE: EXCLUDED FROM CMAQ FUNDING UNDER TEA-21

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Growth Forecasts for Year 2045

MAGLEV ridership projections for the California Project are to extend to the year 2045. Since this is beyond the typical time horizon for which forecasts of demographic and employment data are available, the basis for 2045 ridership projections are derived from other sources. We have evaluated what supplementary data sources are available to assist in extrapolating from the SCAG 2025 forecast horizon to 2045, concentrating on likely changes in population in the project corridor as the primary demographic variable. A secondary variable important in ridership projections and in extrapolating to future year conditions is jobs or employment.

Table G-9

1997 SCAG Model Socioeconomic Input Data				
Population and Workers				
County	**Population**	**Resident Population**	**Group Quarter Population**	**Total Zonal Workers**
Los Angeles	9,359,623	172,713	9,532,336	3,993,841
Orange	2,679,076	21,490	2,700,566	1,502,320
Riverside*	1,345,632	21,605	1,367,237	516,105
San Bernardino*	1,551,859	35,705	1,587,564	613,408
Ventura	713,775	11,959	725,734	353,511
Total	**15,649,965**	**263,472**	**15,913,437**	**6,979,185**
County	**Population**	**Resident Population**	**Group Quarter Population**	**Total Zonal Workers**
Los Angeles	1,518,530	1,550,675	3,069,205	3.05
Orange	453,624	434,055	887,679	3.02
Riverside*	278,378	169,120	447,498	3.01
San Bernardino*	337,968	161,969	499,937	3.10
Ventura	147,462	85,293	232,755	3.07
Total	**2,735,962**	**2,401,112**	**5,137,074**	**3.05**
County	**K thru 12 Enrollment**	**College and University Enrollment**		
Los Angeles	1,768,531	562,694		
Orange	478,433	176,051		
Riverside*	291,154	48,064		
San Bernardino*	368,807	65,218		
Ventura	144,685	28,624		
Total	**3,051,610**	**880,651**		
County	Retail Employment	Service Employment	Other Employment	Total Employment
Los Angeles	657,936	1,652,746	1,988,320	4,299,002
Orange	246,165	583,285	515,697	1,345,147
Riverside*	84,561	154,712	182,032	421,305
San Bernardino*	105,647	189,028	239,397	534,072
Ventura	53,491	96,665	143,697	293,853
Total	**1,147,800**	**2,676,436**	**3,069,143**	**6,893,379**
* County totals are for the part of the County in the SCAG modeling area only.				
Source: Southern California Association of Governments.				

It was determined that the best potential sources of future year population estimates for more distant horizon years include the U.S. Census Bureau and the California

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Department of Finance (DOF), Demographic Research Unit. Potential sources of future year jobs estimates include the Bureau of Labor Statistics (BLS) and the Bureau of Economic Analysis (BEA).

For this project, it was determined that the DOF forecasts are the most appropriate. The DOF Demographic Research Unit is designated the "official source of demographic data for state planning and budgeting." It provides projections of population at the state and county levels by year to 2040. Population estimates are reported for various categories, including age, sex, and ethnicity. Several data series are published by the DOF. Included in this document are population projections by (1) 10-year increments by age and ethnicity, and (2) yearly increments by ethnicity. The attached series are for the three southern California counties in which MAGLEV alignments are under study:

- ü Los Angeles
- ü Riverside
- ü San Bernardino

A state-level summary is also available by 10-year interval. The DOF series thus covers the SCAG forecast horizon and 20 years beyond, but not the period 2040-2045. The projections do not go below the county level, to city and/or place, as do the SCAG projections.

The U.S. Census Bureau projections are of the resident population for the nation and each of the 50 states, with a breakdown by age, sex, race and Hispanic origin by year to 2025. No detail below the state level is available for long-term projections. The projections time series thus overlaps, but does not extend beyond, what is available in more detail from SCAG.

The DOF projections are the more useful data set. They can be compared to the corresponding SCAG county-level projections to 2025 as a reasonableness check. Thereafter, either the data points or the implicit growth rates in the data series can be used to develop demographic assumptions for the MAGLEV Phase I ridership and revenue forecasts. The DOF population projections have been evaluated to determine the (1) simple annual growth rates in county populations; (2) 10-year simple growth rates, and (3) annualized growth rates (i.e., average annual compound growth rate) for each 10-year period starting with the 1990 U.S. census.

To obtain 2045 population estimates from the DOF series requires extrapolation from 2040 values. Various approaches can be used to extend forecasts, including straight-line trend analysis, best fit of data lines/curves, or application of annualized growth rates for a representative period, among other methods. Upon review of the DOF data over the last 5 to 10 years of each series, it was determined that relatively simple, straightforward methods could be used to estimate reasonable 2045 population totals and/or population growth rates for all three counties. The following assumptions were used to estimate 2045 county totals, which are shown in Table G-10.

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Los Angeles County: 0.87% annual growth in population from 2040 to 2045. The growth rate is representative of the implicit DOF growth rate for the period 2030-2040, which was quite constant.

Riverside County: Declining simple annual growth rate for each year from 2040 to 2045. Population grows each year, but at a declining rate, from 2.18% between 2040-41 to 2.14% between 2044-45. This follows the general pattern in the DOF series between 2035-2040.

San Bernardino County: Declining simple annual growth rate for each year from 2040 to 2045. Population grows, but at a declining rate, from 2.02% between 2040-41 to 1.98% between 2044-45. This follows the pattern in the DOF series between 2030-2040.

By these assumptions, all three counties continue to grow beyond 2040 but Los Angeles' population will grow slowly (below the implicit growth rate in state population) and Riverside's and San Bernardino's populations will grow more rapidly (above the implicit growth rate in state population).

Jobs. No source of jobs estimates beyond 2025 comparable to that for population estimates appears to be available. The BLS jobs information for future periods is limited, with SCAG providing more extended forecasts. The BEA forecasts jobs by industry to 2045—and therefore covers the desired 2045 time horizon—but does not provide detail below the state level.

In the absence of another identified source for 2045 data on jobs in the project study area, the BEA data for California has been summarized in Table G-11. Simple period and annualized growth rates have been calculated. The annualized growth rates indicate that total employment in California will likely grow more slowly (0.5-1.5% a year) than state total population (1.3-1.5% a year).

Table G-10

California Department of Finance, Demographic Research Unit
County Population Projects to 2045 (Extrapolated)

Place/County	Year	Total Population	Growth from Prior Period (%)	Annualized Growth Rate (%)
Los Angeles	1990	8,901,987		
Los Angeles	2000	9,838,861	10.52	1.01
Los Angeles	2010	10,604,452	7.78	0.75
Los Angeles	2020	11,575,693	9.16	0.88
Los Angeles	2030	12,737,077	10.03	0.96
Los Angeles	2040	13,888,161	9.04	0.87
Los Angeles	2045	14,495,712	4.37	0.86
Riverside	1990	1,194,623		
Riverside	2000	1,570,885	31.5	5.63
Riverside	2010	2,125,537	35.31	6.23

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Riverside	2020	2,773,431	30.48	5.47
Riverside	2030	3,553,281	28.12	5.08
Riverside	2040	4,446,277	25.13	4.59
Riverside	2045	4,947,672	25.12	2.16
San Bernardino	1990	1,436,696		
San Bernardino	2000	1,727,452	20.24	3.75
San Bernardino	2010	2,187,807	26.65	4.84
San Bernardino	2020	2,747,213	25.57	4.66
San Bernardino	2030	3,425,554	24.69	4.51
San Bernardino	2040	4,202,152	22.67	4.17
San Bernardino	2045	4,639,515	22.66	2.00
Source: California Department of Finance (population to 2040); PTG (2045 population & growth rate)				

Table G-11

Bureau of Economic Analysis Regional Accounts Data, Regional Jobs Projections to 2045				
Place/State	Year	Total Jobs	Growth from Prior Period (%)	Annualized Growth Rate (%)
California	1990	17,028,800		
California	2000	18,601,400	9.23	0.89
California	2010	21,542,900	15.81	1.48
California	2015	22,544,900	4.65	0.91
California	2025	23,696,700	5.11	0.5
California	2045	26,735,900	12.83	0.61
Source: BEA (Total Jobs); PTG (Growth Rates)				

Regional Trip Generation

Today, the SCAG modeling region generates a massive number of trips for an average weekday.

The 1997 base year person-trip generation model estimated that 51,778,626 person trips were generated on a typical weekday in 1997 in the SCAG region’s expanded modeling area. Table G-12 identifies the person-trip summary of those trips, by county and by trip purpose. The last summary total for the 1994 SCAG regional travel model was 46,470,932 person trips (the 1994 model did not account for non-motorized trips). The previous results are based on a smaller modeling area and used a different set of trip generation and trip attraction models. Considering the 51,778,626 total daily person trips in 1997, the home-base work trips were only 17.1 percent, or 8,852,168.

Table G-13 provides a comparison of statistics for person trips, by county and for the modeled portion of the SCAG region. The table identifies certain comparative statistics, such as trips per dwelling unit, trips per vehicle owned, and trips per capita (person). Table G-13 also identifies statistics for home-work trips, and for total trips. Trips per dwelling unit, trips per vehicle, and trips per capita within the SCAG region were slightly higher than those used in the older 1994 base year SCAG travel model.

Table G-12

1997 Trip Generation Summary by Trip Purpose and by County

Trip Purpose Category	Person Trip Productions					Total
	Los Angeles	Orange	Riverside	San Bernardino	Ventura	
HB Work: Direct – Low Income	757,983	188,715	97,885	108,912	42,199	1,195,694
HB Work: Direct – Middle Income	1,767,555	577,470	266,594	294,102	129,834	3,035,555
HB Work: Direct – High Income	1,903,232	877,003	233,110	263,530	210,940	3,487,815
HB Work: Strategic – Low Income	105,684	23,239	12,895	13,679	5,197	160,694
HB Work: Strategic – Middle Income	261,751	82,739	43,087	48,918	20,152	456,647
HB Work: Strategic – High Income	277,481	125,772	36,928	43,220	32,362	515,763
Total HB Work: Direct and Strategic	**5,073,686**	**1,874,938**	**690,499**	**772,361**	**440,684**	**8,852,168**
HB Elementary – High School Trips	2,580,286	698,034	424,794	538,089	211,095	4,452,298
HB College/University Trips	820,972	256,858	70,125	95,153	41,762	1,284,870
HB Shopping Person Trips	2,773,603	946,513	414,004	465,535	246,706	4,846,361
HB Social-Recreational Person Trips	3,101,320	1,057,729	460,544	526,965	279,469	5,426,027
HB Other Purpose Person Trips	6,060,360	2,140,137	908,047	1,031,048	560,629	10,700,221
Work – Other Person Trips (NHB)	3,191,896	1,198,818	426,930	480,127	280,062	5,577,833
Other – Other Person Trips (NHB)	6,239,470	1,903,837	934,190	1,057,180	504,171	10,638,848
Total Production Totals	**29,844,593**	**10,076,864**	**4,329,133**	**4,966,458**	**2,564,578**	**51,778,626**

Notes: HB – Home-Based, NHB – Non-Home-Based

Source: Southern California Association of Governments.

Table G-13

1997 Trip Generation Comparative Statistics

(a) Home-Based Work Trips	County: Los Angeles	Orange	Riverside	San Bernardino	Ventura	Modeling Area Total
Trips	5,073,686	1,874,938	690,499	772,361	440,684	8,852,168
Trips per Dwelling	1.65	2.11	1.54	1.54	1.89	1.72
Trips per Vehicle	0.90	1.02	0.84	0.81	0.86	0.91
% Home-Based Work Trips	17.00%	18.60%	16.00%	15.60%	17.20%	17.10%

(b) Total Trips	County: Los Angeles	Orange	Riverside	San Bernardino	Ventura	Modeling Area Total
Trips	29,841,593	10,076,864	4,329,133	4,966,458	2,564,578	51,778,626
Trips per Dwelling	9.72	11.35	9.67	9.93	11.02	10.08
Total Vehicle Owned	5,612,341	1,845,829	819,438	958,338	510,190	9,746,136
Trips per Vehicle	5.32	5.46	5.28	5.18	5.03	5.31
Trips per Capita	3.13	3.73	3.17	3.13	3.53	3.25

Source: Southern California Association of Governments.

Base Year 1997 Trip Distribution Between MAGLEV Markets

As Table G-14 shows, the SCAG Regional Travel Model distributes many trips between MAGLEV station market areas for the 1997 base year. The trip distribution in the base year model was validated against the most recent Regional Home Interview Travel Survey (RHITS) for the SCAG region in southern California. The trip distribution was also rigorously checked against other available travel information and ground counts.

MAGLEV station market catchment areas vary from 8 to 11 kilometers (5 to 7 miles) for stations on the western end of the corridor to 11 to 19 kilometers (7 to 12 miles) on the eastern end (Ontario, Riverside, and March). As shown in the exhibit, nearly 1.7 million long distance trips are distributed between the six MAGLEV station market areas for the candidate alternative for base year 1997.

The table has excluded station to next station trip interchanges for station catchment areas east of the San Gabriel Valley (City of Industry). As expected, the greatest attractors of long distance trips in the corridor are the LAX-El Segundo area and central Los Angeles, the region's two largest concentrations of employment.

The new SCAG Regional Travel Model Base Year Validation was completed earlier in the year 2000.

Table G-14

1997 Base Year – Market to Market Trip Distribution

HOME BASED WORK TRIPS
Peak Period

District From		District To						
		LAX	Union Station	Industry	Ontario	Riverside	March	Total
District From	LAX		129,803	15,157	636	23	-	145,619
	Union Station	118,446		31,268	2,853	102	4	152,673
	Industry	19,978	57,972			5,249	175	83,374
	Ontario	2,062	9,882				4,619	16,563
	Riverside	237	1,917	7,649				9,803
	March	449	6,966	14,275	51,565			73,255
	Total	141,172	206,540	68,349	55,054	5,374	4,798	**481,287**

HOME BASED WORK TRIPS
Off-Peak Period

District From		District To						
		LAX	Union Station	Industry	Ontario	Riverside	March	Total
District From	LAX		61,394	6,020	239	27	-	67,680
	Union Station	53,918		12,593	817	41	-	67,369
	Industry	6,403	19,476			1,310	106	27,295
	Ontario	1,328	4,789				2,501	8,618
	Riverside	241	502	3,569				4,312
	March	1,059	3,018	6,343	22,605			33,025
	Total	62,949	89,179	28,525	23,661	1,378	2,607	**208,299**

HOME BASED WORK TRIPS
Composite

District From		District To						
		LAX	Union Station	Industry	Ontario	Riverside	March	Total
District From	LAX		191,197	21,177	929	50	-	213,353
	Union Station	172,364		43,861	3,670	143	4	220,042
	Industry	26,381	77,448			6,559	281	110,669
	Ontario	3,390	14,671				7,120	25,181
	Riverside	478	2,419	11,218				14,115
	March	1,508	9,984	20,618	74,170			106,280
	Total	204,121	295,719	96,874	78,769	6,752	7,405	**689,640**

NON-HOME BASED WORK TRIPS Peak Period								
		District To						
		LAX	Union Station	Industry	Ontario	Riverside	March	Total
District From	LAX		159,839	7,727	556	37	5	168,164
	Union Station	137,256		22,605	2,903	121	31	162,916
	Industry	7,665	31,010			2,854	1,044	42,573
	Ontario	668	2,485				29,127	32,280
	Riverside	46	108	3,681				3,835
	March	20	59	2,530	28,325			30,934
	Total	145,655	193,501	36,543	31,784	3,012	30,207	**440,702**

NON-HOME BASED WORK TRIPS Off-Peak Period								
		District To						
		LAX	Union Station	Industry	Ontario	Riverside	March	Total
District From	LAX		180,803	10,751	1,002	68	37	192,661
	Union Station	173,588		28,376	3,401	123	86	205,574
	Industry	10,645	31,911			2,481	1,450	46,487
	Ontario	1,440	3,663				25,540	30,643
	Riverside	1,440	3,663	7,354				12,457
	March	143	280	8,026	56,551			65,000
	Total	187,256	220,320	54,507	60,954	2,672	27,113	**552,822**

NON-HOME BASED WORK TRIPS Composite								
		District To						
		LAX	Union Station	Industry	Ontario	Riverside	March	Total
District From	LAX		340,642	18,478	1,558	105	42	360,825
	Union Station	310,844		50,981	6,304	244	117	368,490
	Industry	18,310	62,921			5,335	2,494	89,060
	Ontario	2,108	6,148				54,667	62,923
	Riverside	194	361	11,035				11,590
	March	163	339	10,556	84,876			95,934
	Total	331,619	410,411	91,050	92,738	5,684	57,320	**988,822**

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TOTAL TRIPS
Peak Period

		District To						
		LAX	Union Station	Industry	Ontario	Riverside	March	Total
District From	LAX		289,642	22,884	1,192	60	5	313,783
	Union Station	255,702		53,873	5,756	223	35	315,589
	Industry	27,643	88,982			8,103	1,219	125,947
	Ontario	2,730	12,367				33,746	48,843
	Riverside	283	2,025	11,330				13,638
	March	469	7,025	16,805	79,890			104,189
	Total	286,827	400,041	104,892	86,838	8,386	35,005	**921,989**

TOTAL TRIPS
Off-Peak Period

		District To						
		LAX	Union Station	Industry	Ontario	Riverside	March	Total
District From	LAX		242,197	16,771	1,295	95	37	260,395
	Union Station	227,506		40,969	4,218	164	86	272,943
	Industry	17,048	51,387			3,791	1,556	73,782
	Ontario	2,768	8,452				28,041	39,261
	Riverside	389	755	10,923				12,067
	March	1,202	3,298	14,369	79,156			98,025
	Total	248,913	306,089	83,032	84,669	4,050	29,720	**756,473**

TOTAL TRIPS
Composite

		District To						
		LAX	Union Station	Industry	Ontario	Riverside	March	Total
District From	LAX		531,839	39,655	2,487	155	42	574,178
	Union Station	483,208		94,842	9,974	387	121	588,532
	Industry	44,691	140,369			11,894	2,775	199,729
	Ontario	5,498	20,819				61,787	88,104
	Riverside	672	2,780	22,253				25,705
	March	1,671	10,323	31,174	159,046			202,214
	Total	535,740	706,130	187,924	171,507	12,436	64,725	**1,678,462**

ALTERNATIVES AND BACKGROUND ASSUMPTIONS TO BE MODELED

During Phase I of the California MAGLEV Deployment Project, numerous east–west alignments and station locations were studied to determine feasibility and ridership potential. Some of these alignments are along freeway ROWs, while others are along railroad lines. For travel demand modeling purposes, the differences between some of the candidate alignments and stations were too limited to noticeably affect ridership. Therefore, model runs were limited to those combinations of MAGLEV alignments with substantially different attributes, line lengths, and travel times.

Alignment Alternatives for Modeling

After careful analysis, the five alignment and station alternatives shown in Table G-15 were selected for initial testing in Phase I of the Project. Later in the project, it is possible that additional alignments and station options may be tested as they are brought forward by the station planning team.

As Table G-15 shows, the end-to-end travel time for the MAGLEV alternatives ranges from 53 minutes for Alternatives 7 and 8 (five-station alternatives) to 64 minutes for Alternative 3 (Mid-Corridor I–210, with a station in Irwindale). Average operating speeds are about 147 km/hr (92 miles per hour) including station stops averaging 90 seconds each.

Alternatives designated with an “M” indicate a model run using the new mode choice nest developed based on market research. Alternative 2MH indicates a run of 2 M at a 20-minute headway (both peak and off-peak times of the day).

Alternatives 2 through 8 contain the same background roadway and transit system tested in the 2020 No-Build Alternative. For consistency and conformity, the 2020 No-Build Alternative includes the planned roadway and transit improvements found in the 1998 Regional Transportation Plan (RTP98).

Table G-15

MAGLEV Alignment Alternatives for Modeling for 2020						
Alternative Number and Name		**Alignment Combinations**	**End-to-End Travel Time**	**Length (miles)**	**No. of Stations**	**Station Locations**
1	2020 No-build	None	0	0	None	None
2, 2M, 2MH	EA MAGLEV	B/F-2/K	53 minutes	82	6	LAX, Union Station, City of Industry, Ontario Airport, downtown Riverside, March Inland Port
3 and 3M	Mid-Corridor (I-210)	B/E-1/K	64 minutes	94	6	LAX, Union Station, Irwindale Ontario Airport, downtown Riverside, March Inland Port
4 and 4M	Mid-Corridor (I-10)	B/F-1/K	56 minutes	87	6	LAX, Union Station, West Covina, Ontario Airport, downtown Riverside, March Inland Port
5 and 5M	West Los Angeles	A-1/F-2/K	63 minutes	90	7	LAX, West Los Angeles, Union Station, City of Indutry, Ontario Airport, downtown Riverside, March Inland Port

Alternative Station Locations

Eleven individual MAGLEV stations were studied in Phase I. The three mid-corridor (San Gabriel Valley) and two Riverside stations are on different competing alignments. The nine stations included in MAGLEV networks and model runs include:

***Los Angeles* International Airport**. Several alternative sites for station locations are compatible with (LAWA) Master Plan. It has been suggested that a separation between commuters, airport passengers, and freight platforms might be desirable, given the traffic and parking demands in and around the terminals.

The Phase 1 MAGLEV option modeled—the lowest-cost option—connects to LAX Terminal 1 at the northeast corner of the terminal complex. Other alternatives would tunnel under the terminals or parking structures and connect the MAGLEV station to the terminals via underground walkways or moving sidewalks. It is possible that tunneling under the terminals or parking structures would be too disruptive. However, future Master Plan development might make that option more attractive.

The proposed extension of the north side runways most likely means future MAGLEV connections will be underground. The MAGLEV system would connect to one or both the existing terminal complex and new western terminal. Future MAGLEV alternatives will not be needed until the Master Plan is under way.

West Los Angeles. A station location northeast of the I–10/I–405 interchange was included for modeling. It is near the intersection of Pico and Overland. In addition to this site, other station locations were studied in west Los Angeles during Phase I of the MAGLEV project. It may be possible that the benefits of a station in west Los Angeles outweigh the costs (including additional route-miles, extra station costs and impacts).

Los Angeles Union Station. Discussions with Catellus (the site property owner) and the Los Angeles County Metropolitan Transportation Authority (MTA) have resulted in a possible platform above the Metrolink tracks at Los Angeles Union Station. A platform for MAGLEV might be integrated into the rear of one or more planned buildings on the west side of the existing tracks.

San Gabriel Valley. Several locations were discussed with the San Fernando Valley Council of Governments (SFVCOG). Discussions were also conducted with member Cities about locations (Irwindale, West Covina, and City of Industry), Caltrans, and affected parties. For modeling, stations in Irwindale near the I–605/I–210 interchange, West Covina Mall off of I–10 and the City of Industry Metrolink Station were tested.

Ontario International Airports. As a result of discussions with Ontario Airport management and Ontario city staff, a single (multiplatform) station concept sited directly north of the new terminals has been developed and was tested. Passengers connecting between the MAGLEV train and the airport would have a short walk on a second level. Commuters could use a companion platform in the same station.

Central Riverside. After discussions with Riverside city staff, a site was identified for testing at the north edge of the downtown area south of SR 91 near Main Street, along Spruce Street. It is possible that this site would help spur redevelopment in the area and also is clear of the area needed for the reconstruction of the SR 91/SR 60/I–215 interchange.

March Inland Port. Discussions were held with March Joint Powers Authority (JPA) staff that resulted in a tentative station siting near the west side of I–215, north of Van Buren Boulevard. The civilian segment of the airport is in early planning and development. As the development plan matures and the JPA selects a terminal site, other locations on either side of I–215 can be considered. Because of its strategic location adjacent to I–215 and Allesandro, the current station site is a prime joint development site.

West Covina Mall. The Mall of West Covina is adjacent to the I–10 freeway and is strategically placed to serve several nearby population centers within the San Gabriel Valley.

Iwrindale. This station site is close to the I–210/I–605 interchange and could function as a key intercept site along the I–210 corridor.

MAGLEV Performance Specifications

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MAGLEV trains can achieve a much higher top end speed than conventional urban rail 384 kilometers per hour (240 miles per hour) versus 112 kilometers per hour (70 mph). Therefore, its average operating speeds in 5, 6, and 7 station scenarios are expected to exceed 144 km/hr (90 miles per hour) end-to-end for the entire 131 kilometer (82 mile) corridor.

Given its substantial travel time advantage over competing modes of travel, the EA alignment running from LAX–El Segundo to March Inland Port is expected to generate significant ridership by 2020. The B/F-2/K alignment is being analyzed with six passenger stations spaced an average of about 22.4 km (14 miles) apart. Passenger boarding and alighting activity will occur at these stations throughout most of the day, but will be most pronounced in the morning and evening commute periods (6–9 AM and 4–7 PM). Weekend service is expected to be warranted soon after the system opens in 2010.

In spite of 90-second station dwells, MAGLEV trains will have a high average operating speed on the six-station set of EA alignments, service will be of sufficient frequency to attract premium riders with an AM peak period westbound headway of either 10 or 20 minutes from March Inland Port. Off-peak and weekend headways will range from 15 to 20 minutes.

As Table G-16 shows, MAGLEV in the LAX–March corridor will achieve a substantial travel time advantage over automobile travel during peak congested periods. Station-to-station travel times for MAGLEV are projected to exceed congested auto travel times by as much as 87 minutes in year 2020. Of course, station access and egress time would reduce the savings somewhat.

Feeder/Distributor Services

Interface with Other Transit Modes

Primary interface with other rail modes (Metrolink commuter rail and Metro Rail Blue and Red lines) would occur at Union Station. All MAGLEV stations are assumed to have some degree of feeder bus or shuttle service to connect stations with the surrounding communities. A station-by-station description of access and intermodal connections is described in the following paragraphs.

Peak hour traffic impacts at stations can be lessened by instituting variable pricing of MAGLEV passenger fares to encourage riders to shift to shoulder peak hours or off-peak periods. In addition, this type of fare program would allow for a better optimization of the MAGLEV system and feeder services. Peak hour fares will be distance-based and range from $10.00 to $22.00. Off-peak fares will range from $6.00 to $15.00.

Table G-16

AM Peak Travel Time Comparisons Between MAGLEV and Automobile Travel for Year 2020

Between Stations (Travel Time in Minutes)
For the Candidate MAGLEV Alternative (2 MH)[1]

	LAX	Union Station	Industry	Ontario	Riverside	March
LAX		11.38	26.87	34.56	44.87	53.36
Union Station	11.38		13.99	21.68	31.99	40.48
Industry	26.87	13.99		6.19	16.5	24.99
Ontario	34.56	21.68	6.19		8.81	17.3
Riverside	44.87	31.99	16.5	8.81		6.99
March	53.36	40.48	24.99	17.3	6.99	

AM Peak Automobile Travel Times Between Stations[2]

	LAX	Union Station	Industry	Ontario	Riverside	March
LAX		35.31	58.14	75.28	95.08	110.44
Union Station	35.31		35.98	56.6	77.31	93.38
Industry	58.14	35.98		19.71	39.5	54.87
Ontario	75.28	56.6	19.71		19.8	35.16
Riverside	95.08	77.31	39.5	19.8		15.36
March	110.44	93.38	54.87	35.16	15.36	

MAGLEV Travel Time Savings Over AM Peak Auto Travel
Non-Peak Direction Savings

	LAX	Union Station	Industry	Ontario	Riverside	March
LAX		23.93	31.27	40.72	50.21	57.08
Union Station	23.93		21.99	34.92	45.32	52.9
Industry	31.27	21.99		13.52	23.01	29.87
Ontario	40.72	34.92	13.52		10.99	17.86
Riverside	50.21	45.32	23.01	10.99		8.37
March	57.08	52.9	29.87	17.86	8.37	

[1] MAGLEV Travel Times include a 90 second dwell time per station
[2] Peak Automobile Travel Times between stations range from 27 to 45 miles per hour for year 2020
Source: SCAG Regional Travel Demand Model

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Table G-17

California MAGLEV Deployment Program Year 2020
Station Definitions for the EA Alternative

MAGLEV Station	Station Access	Connection to other Modes	Cities Served
1. LAX	I-105/Sepulveda	∉# Metro Green Line	∉# Los Angeles
	I-105/Sepulveda	∉# 98th Street Bus Transit	∉# El Segunda
	I-405/Century	Center MTA, LADOT, Other	∉# Inglewood
	I-405/Imperial	Municipal Bus Operations	
2. Union Station	I-110/Hill Street	∉# Metrolink Commuter Rail	∉# Downtown
Station	US-101/Alameda Street	∉# Metro Blue and Red Line	Los Angeles
	I-5/N. Main Street	Rail	
		∉# MTA and LADOT Bus	
3. Mid Corridor -	Brea Canyon Rd./SR 60	∉# Metrolink Commuter Rail	∉# City of Pomona
City of Industry	Grand Ave./SR-60	∉# Foothill Transit Bus	∉# City of Diamond Bar
	E. Valley Blvd./SR-57	∉# MTA Transfer Bus	∉# City of Walnut
	Temple/SR-57	∉# Smart Shuttle	
4. Ontario Airport	Haven Ave./I-10	∉# Omnitrans Bus	∉# City of Ontario
	N. Archibald/I-10	∉# Smart Shuttle	∉# City of Rancho
	Jurupa/I-15		Cucamonga
5. Central Riverside -	Market/SR 60	∉# RTA Bus	∉# City of Riverside
Vicinity of SR 60/	Main/SR 60	∉# Smart Shuttle	
SR 91	Poplar/SR 91		
6. March Inland Port	Van Buren/I-215	∉# RTA Bus	∉# City of Moreno Valley
	Cactus/I-215	∉# Smart Shuttle	∉# City of Perris
	Alessandro/I-215		∉# City of Riverside

Table G-17 summarizes the transit interconnections assumed for the six stations in the B/F-2/K MAGLEV alignment. The range of estimates for station parking demand for year 2020 shown in the exhibit have been derived from corridor market research and available corridor trip tables. Model-derived MAGLEV travel demand forecasts produced later during this phase will be used to further analyze station activity.

1. *LAX Station* – A station sited near LAX can be accessed in a number of ways from the I–105 and I–405 freeways. The siting of the station near the Metro Green Line rail station at Aviation and Imperial Highway and the 98th Street Bus Transit Center will allow for good connections to other transit modes. Access to and from the LAX passenger terminals will be provided by shuttles, with the possibility of a people mover connection in the future (one is now being planned as part of the LAX master planning effort). Given that the LAX MAGLEV station will largely function as a destination station (for air travelers and employees destined for LAX and the sizable

concentration of jobs in El Segundo), parking demand at the station will be lower than at most other stations.

2. *Los Angeles Union Passenger Terminal (Union Station)* – The station at Union Station will function as the primary destination station on the MAGLEV line. It serves downtown Los Angeles and the greater central Los Angeles area. The station will have the highest passenger activity of any of the MAGLEV stations because it serves the Los Angeles Basin's largest concentration of jobs, is in close proximity to several downtown special events/special generators, and facilitates direct interconnects to several local and regional transit services. These services include six Metrolink commuter rail lines, several Amtrak trains, the Metro Red Line subway, and numerous bus services. Given the nature of the station, auto access and parking demand at the station will be low to moderate.

3. *Mid-Corridor Station – City of Industry* – Several sites in the City of Industry along the Union Pacific Railroad line are under analysis for a Mid-Corridor station along alignment F-2. These sites are northwest of the SR 57/SR 60 interchange and include the City of Industry Metrolink station. Access to the Mid-Corridor station from the SR 60 would be via Brea Canyon Road and Grand Avenue. Access from SR 57 would be via East Valley Boulevard and Temple. MTA and Foothill Transit operate bus fixed route service here. Since the mid-corridor station would function as a primary access station for several surrounding communities, sizable demand for parking will be needed.

4. *Ontario Airport* – The Ontario Airport station will function as a multipurpose station that serves commute trips to Los Angeles (Central Business District and LAX–El Segundo), air passenger trips to LAX, and other trip purposes. Because it is well situated to be an intercept point for travelers on the I–10 and I–15, the station will generate a high level of peak passenger activity and will require a large amount of parking. The majority of this parking demand would be for commuters to Los Angeles. If separate boarding areas for commuters and air passengers are established, separate parking lots for commuters and air passengers might be appropriate. Omnitrans provides bus service in the Ontario area and is planning to institute a smart shuttle demonstration service for the area near the airport.

5. *Central Riverside – Vicinity of SR 60/SR 91* – Several sites in Riverside near the SR 60/SR 91 interchange are being analyzed for a MAGLEV station. Riverside Transit Agency serves the Riverside area.

6. *March Inland Port* – A station at March Inland Port will function as the eastern terminus of the 131.2 kilometer (82 mile) MAGLEV line. The station would be accessed from the I–215 via Alessandro, Cactus, or Van Buren. As is the case with all other MAGLEV stations that will have large numbers of originating trips, smart shuttle and feeder bus services would be maximized to lessen auto access trips to the station. The Riverside Transit Agency serves the area surrounding March Inland Port.

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New Feeder Services – Smart Shuttle Case Study Access to Ontario Station

MAGLEV stations on the eastern end of the corridor from the San Gabriel Valley to March Inland Port lack the substantial transit infrastructure (background bus line density) that exists in Los Angeles. For an investment of the magnitude of MAGLEV, it is assumed that agencies, nearby trip generators, and communities would consider enhancing feeder services to and from MAGLEV stations. Therefore, additional feeder services have been added into the regional travel demand model to support MAGLEV.

To demonstrate how enhanced station access could work to/from a MAGLEV station, a smart shuttle case study was conducted for the Ontario Station near Ontario Airport. The city of Ontario and Omnitrans, the local transit operator, are already planning a smart shuttle operation to serve the airport and surrounding trip generators in advance of MAGLEV, beginning operation in 2010.

This service could also serve the New Colony of Ontario, to be built starting in 2002 on the old agriculture preserve in the southwestern part of the City of Ontario. The balanced community will have about 16,000 completed dwelling units and over 50,000 people by 2010. (The city of Ontario will approach a population of 200,000 by 2010.) Ultimately, the New Colony in the City of Ontario will hold 31,000 dwelling units and over 100,000 people.

Four Smart Shuttle Markets

The Ontario Smart Shuttle system will bring a variety of travelers to the MAGLEV station adjacent to Ontario Airport. Some will be commuters (traveling during peak hours) or visitors (primarily traveling during off-peak hours) going to Los Angeles or Riverside for the day. Others will be air passengers flying out of Ontario Airport or LAX. Smart Shuttles can also transport residents and visitors around the city of Ontario, taking them to the Convention Center, Ontario Mills, the proposed sports arena or many other destinations. In addition, Smart Shuttles may also serve portions of the cities of Upland, Rancho Cucamonga, and Fontana.

Shuttles may also connect to the California Speedway and the Epicenter Baseball Stadium. Table G-18 shows ridership estimates for each market in 2010 and 2020. Using clean-fuel vehicles, the system will help many people go where they want without having to use cars, and without having to look for a parking place. Ride reservations can be conveniently made by telephone or over the Internet.

Table G-18

Ridership Estimates for Ontario Smart Shuttle Typical Weekdays in 2010 and 2020		
Category of Rider	2010	2020
Commuters to MAGLEV		
6–9 AM	300 – 550	600 – 800
4–7 PM	300 – 550	600 – 800
Off-peak MAGLEV Riders		
9 AM – 4 PM and after 7 PM	300 – 500	500 – 700
Air Passengers to Ontario or MAGLEV		
6 AM – 10 PM	800 – 1,000	1,100 – 1,500
Local Community Trips		
6 AM – 10 PM	300 – 500	500 – 8000
Total Trips	**1,700 – 2,800**	**3,000 – 4,100**

Commuters

Soon after the MAGLEV system opens in the year 2010, planners expect thousands of commuters to board the system at the Ontario station every weekday morning. They will arrive in a variety of ways. Some will walk from airport terminals. Most will drive and park, or be dropped off. Others will take Omnitrans feeder buses to the station. In an attempt to lessen automobile traffic impact and lower parking demand, new station feeder services in the form of Smart Shuttles can be put into operation. It is estimated that a well-planned Smart Shuttle service can attract between 300 and 550 commuters destined for the Ontario MAGLEV station each weekday morning. About 200 or so may arrive in the busiest hour, between 7:00 AM and 8:00 AM.

Travelers going to the airport by Smart Shuttle can make ride reservations in advance. Regular riders can have standing Smart Shuttle reservations, and would only need to call the system if they want to make a change. Others will make reservations by phone or over the Internet. Smart Shuttle fares are expected to be similar to or a little more than local service on Omnitrans buses. (Omnitrans currently charges $1.00 per ride for local service.) Smart Shuttle fares can be charged separately or packaged with the train fares.

To keep ride times short, small vehicles could make no more than three or four pick-ups per trip. Most pick-ups will be of individuals, although there may be some small group loads. Customers may be picked up in front of their houses or at a nearby corners or sheltered bus stops. Dispatchers may use computer-assisted dispatch and geographic information system software to find the optimum routes for collecting passengers. The city may also establish a few centrally-located park and ride lots, where people without reservations can fill in the empty seats of passing Smart Shuttles on a space-available basis. There will be convenient pick-up and drop-off areas for commuters getting rides to the lots. Once on board, riders could use their train passes, fare-debit or credit cards to pay or record their fares. Regular riders will have established accounts and receive periodic reports on usage. After the last pick-up, the Smart Shuttle vehicle will drive straight to the MAGLEV station, use a special entrance to bypass other vehicles waiting to enter the parking lot, and drop off passengers very close to the boarding platform.

Coming home, commuters would have several choices. For instance, they can make a Smart Shuttle reservation for a specific time or for a specific train. Automatic vehicle location equipment on the trains will advise the dispatch center of expected train arrival times. Alternatively, riders waiting to board their homebound MAGLEV train can use a kiosk in the station to request a ride to their home or final destination. The system will determine which train the rider will board and advise dispatch to provide a vehicle at the appropriate time.

After alighting from the MAGLEV train at the Ontario station, Smart Shuttle passengers will walk to the nearby boarding area. The curb captain will assign them to vehicles according to destination, with 7 to 10 passengers per vehicle. The drivers, being familiar with the Ontario area, will determine the most efficient route based on the destinations of the people on board their vehicle. After a while, patterns will develop and regular passengers will be assigned to vehicles parked at designated slots in the boarding area.

Air Passengers

Ontario Airport today carries about 7 to 8 million annual passengers. By the year 2010, the airport will serve as many as 15 million passengers per year. Today, less than 10 percent of all air travelers use shuttles or taxis to travel to or from Ontario Airport. In the future, with increased passenger volume, a different mix of flights and greater congestion in and around the airport, more air passengers will use shuttle services. Also, the existence of a convenient Smart Shuttle system may induce more travelers to use shuttles to and from the airport.

The shuttle service for air passengers coming to Ontario Airport in 2010 will be similar to today’s private airport shuttles in many respects. Passengers going to Ontario, whether destined for Ontario or for LAX, will reserve shuttles by telephone or over the Internet. The airport shuttle vehicles will be able to travel further out than vehicles transporting commuters and will charge distance-based fares. Vehicles will have room to carry luggage and will travel through the airport, dropping off passengers at each terminal. After airline check-in, air passengers going to LAX will walk to the nearby MAGLEV station and board a train for LAX. Eventually, when there is sufficient demand, express trains direct to LAX may be provided. Separate, secure compartments on the train will carry the luggage to LAX.

Returning air passengers, whether landing in Ontario or LAX, will have checked their luggage through to Ontario. It may be necessary for passengers processing through Customs at LAX to claim their luggage and then return it to airport personnel for transport to Ontario. Domestic air passengers landing at LAX will leave the airplane, walk through the airport or take a shuttle to the MAGLEV station, board the train, travel to Ontario, claim their luggage and go to the shuttle boarding area to catch a shuttle home.

Air travelers would be able to reserve shuttle rides in advance by time or in connection with a specific flight or train. They will be able to request rides from the boarding platform at LAX, although this will not necessarily guarantee them a ride immediately upon arrival. Similar to the current practice, shuttle riders will be able to wait at designated stops within Ontario Airport and at the Ontario MAGLEV station to get rides on a space-available basis. At the MAGLEV station, shuttle passengers will be grouped by geographic categories of destinations with the drivers determining the best route.

Local Travelers

The other markets for Smart Shuttle services in Ontario in 2010 will be off-peak MAGLEV passengers and local travelers. Off-peak MAGLEV passengers may be going to downtown Los Angeles or elsewhere for personal or business trips, to attend special events, to shop, etc. Based on output from MAGLEV model runs, between 200 and 400 of these passengers might be carried to the station on Smart Shuttles between 9:00 AM and 3:00 PM, or during the evening.

Currently, the regional transit operator, Omnitrans, provides basic fixed-route transit service in Ontario. Omnitrans has transit hubs at the Ontario Civic Center, Ontario Mills and at the airport. Omnitrans' long-range plans include improving service frequency in major east–west corridors in Ontario and beginning Smart Shuttle service in southwest Ontario in 2005. This Smart Shuttle service will connect the New Colony area with the three transit hubs.

By 2010 there will be demand for additional transit services between the major traffic generators in Ontario: the hotels, the Convention Center, Ontario Mills, the sports arena, downtown, and Ontario Airport. There may also be demand for service between the residential areas and these attractions. Smart Shuttle vehicles may provide some of this service when not in use to and from the MAGLEV station. Service levels will grow with demand.

Operations

Given the estimated demand for Smart Shuttle transportation to Ontario Airport and the Ontario MAGLEV station, a large fleet of shuttle vehicles (at least 30, plus spares) will be required. Commuters alone will need about 14 vehicles to meet peak demands. Air passengers will require another 12 vehicles, although peak demand for air passengers may fall outside the peak period for commuters. Non-work and local Smart Shuttle needs, some of which will coincide with the afternoon peak commute hours, will likely be accommodated with a small number of additional vehicles. Table G-19 describes estimated operating characteristics and fleet requirements.

Table G-19

Estimated Operating Characteristics for Ontario Smart Shuttle in Year 2010				
	Commuters	Air Passengers	Nonwork Travelers	Residents/ Visitors
Passenger/trip	6	5	4	15
Trips/hour	1.8	1.0	1.5	2.0
Passengers per Vehicle Service Hour	10.5	5	6	30.0
Cost/hour	$ 50.00	$ 50.00	$ 50.00	$ 60.00
Cost/passenger	$ 4.76	$ 10.00	$ 8.33	$ 2.00
Fare	$ 1.00	$ 10.00	$ 2.00	$ 1.00
Subsidy/Passenger	$ 3.76	$ -	$ 6.33	$ 1.00
PM Peak hour passengers	150	60	20	20
Fleet requirements (plus spares)	14	12	3	1

Ontario Airport lies in a commercial and industrial area. With few homes nearby, commuters can be expected to travel an average of about 9.6 km (6 miles) to reach the MAGLEV station. This is a longer transit trip than most current rail commuters make. However, the shuttles will offer significant advantages to their riders: shuttle riders will have a separate entrance to the station with virtually no waiting time to enter; once within the station area, shuttle riders will proceed directly to the boarding area; shuttle riders will not wait in a queue to enter the parking lot and will not spend time searching for a parking place; and, of course, shuttle riders will not pay to park.

Intelligent transportation systems technologies continue to evolve at a rapid rate. Automatic vehicle location systems are in use by many transit systems. Metrolink is embarking on a project to equip their trains with automated vehicle locators (AVLs). This feature will be accommodated easily on MAGLEV trains. Computer-assisted dispatch systems for Smart Shuttles currently exist but have yet to achieve their full potential.

However, the capabilities needed for efficient Smart Shuttle dispatching and operations should be in place well before 2010. Travelers may use personal digital assistants, pagers or other devices to communicate with the dispatch system and learn more precisely when to expect to be picked up. If requested, an automated phone system could call travelers when their vehicle is within a few minutes of the pick-up location. Vehicle fuel technology is also evolving rapidly. Smart Shuttle vehicles 10 years from now will be of a design not yet developed. They may be powered by fuel cells or some sort of hybrid-electric engine. Their size depends on expected loads. Commuters will not have the patience to wait through many stops, so small vehicles may be best. However, if significant numbers of riders use the park and ride lots, larger vehicles may be necessary. Air passengers may also be best served by 8 to 10 passenger vehicles. Local service will likely attract larger numbers of people per vehicle and may require 17 to 22 passenger buses. However, service could start with small vehicles and switch to larger ones as demand grows.

Smart Shuttle service can be provided by either public or private entities, or some combination of both. However, service policies and procedures must to be coordinated. A public agency such as the city of Ontario, Omnitrans, or the airport authority would be in the best position to monitor and coordinate services. However, it is not necessary for all the service to be provided by the same operator.

METHODOLOGIES AND MODELING PROCEDURES

Overview

This section provides detailed information on the methodology and procedures used to produce forecasts for ridership and revenues for the California MAGLEV Deployment Project Phase I. Information is provided on all modeling programs and procedures, as well as modifications to certain model features such as mode choice and networks.

Given the broad nature of travel in the LAX–March Inland Port corridor, a variety of forecasting tools were used to forecast ridership and revenue for MAGLEV. Traditional resident-based work and nonwork trips were forecast using the new regional travel demand model. However, this model does not deal with all travel purposes. To forecast air passenger trips, SCAG used the Regional Air Demand Allocation Model (RADAM 4.2) to determine trips attracted to high-speed modes of travel connecting airports.

Visitor trips to special events and special generators were estimated using corridor market research and spreadsheet-based models. Finally, because of its vastly superior travel time advantage, reliability, and attractiveness, MAGLEV was to forecast create induced demand above and beyond trips accounted for from the above categories. The induced demand included trips not previously made by residents of the region but forecast to be made simply because the MAGLEV system exists.

Travel forecasts for the LAX–March corridor for commute to work and resident-based nonwork trips were made in accordance with FRA guidelines. These FRA requirements parallel requirements for major investment studies and include consistency with:

- ü Adopted socioeconomic forecasts for the region
- ü Adopted future networks for the region
- ü Accepted modeling practices
- ü Local travel demand forecasting models

Regional Travel Demand Model

The new travel model SCAG recently implemented formed the basis for the modeling effort. While the model was validated against 1997 conditions and deemed acceptable for travel forecasting for the region, the new highway and transit networks for 2020 were not available when the 2020 MAGLEV forecasts were made.

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As an interim measure, the new travel demand models were applied using the previous SCAG traffic analysis zone (TAZ) system and transportation networks. The previous SCAG zone system included 1,555 TAZs as opposed to 3,217 zones for the revised model (3,191 internal zones and 26 external stations). However, since SCAG maintains socioeconomic data in a geographic information system (GIS), it was possible to aggregate the adopted future population, household, and employment forecasts to the 1,555 zone structure.

The new SCAG travel models were developed using best state-of-the-practice travel demand modeling techniques. Cross-classification models formed the basis for the trip generation models. To provide additional sensitivity and improve trip distribution, trips for nine purposes are generated:

- Home-based work-direct
- Home-based work-strategic
- Home-based elementary/high school
- Home-based college/university
- Home-based shop
- Home-based social-recreational
- Home-based other
- Work-based other
- Other-based other

Home-based work-direct trips are those trips that go directly between home and work, without any intermediate stops. Home-based work-strategic trips are those trips that include an intermediate stop, such as to drop off or pick up a passenger. Home-based work-direct and home-based work-strategic trips are generated for each of three household income groups. Thus, 13 separate trip purposes are carried into the trip distribution step of the regional model.

Unlike many four-step models, the new SCAG models apply time-of-day factors as part of the trip generation step. Thus, trips for both peak and off-peak purposes are forecast for the trip distribution step. This allows trips to be distributed using the travel times that are likely to exist during the time when the trips are made; home-based work trips for the peak period will travel at slower speeds due to congestion than home-based work trips made in off-peak periods.

The new SCAG trip distribution models employ the gravity model form. Using this model form, trips for an interchange are directly proportional to the trip productions and trip attractions at the ends of the interchange and inversely proportional to the travel impedance for the interchange. In keeping with the “best” state-of-the-practice, home-based work trips are distributed based on composite impedances for interchanges. The composite impedance used is the “logsum” variable, which is the denominator of the mode choice model. The logsum variable is sensitive to all transportation options for an interchange rather than just auto travel times. Thus, if improved transit services are added for an interchange, the composite impedance will be reduced, resulting in additional trips on the interchange.

The mode choice model also uses best state-of-the-practice techniques. The SCAG mode choice model required modification to properly model MAGLEV ridership and is discussed in detail in paragraph 5.1.3. Traffic and transit assignment procedures are performed using standard modeling practices. The assignments are performed by time-of-day.

Network Development for the Regional Travel Model

The 2020 roadway and transit networks used for the regional transportation plan (RTP) update were available as a basis for the modeling effort. The networks were consistent with the 1,555-zone structure and were augmented as necessary to represent the various MAGLEV options.

No major changes were made to the 2020 Regional Transportation Plan (RTP98) roadway networks for the MAGLEV modeling. These networks already included all of the planned and programmed roadway improvements described in Section 3.

Several changes were made to transit networks and network coding techniques. These changes were necessary to represent “Smart Shuttle” service and add the MAGLEV mode. Table G-20 shows the modes modeled in the original SCAG travel models, the modes used in the new SCAG travel models in their 1997 model validation effort, and the modes used in the new SCAG travel models (for the MAGLEV ridership forecasts using the interim, 1,555-zone structure). As can be seen in Table G-20, two new modes were included in the interim models: mode 6 to represent Smart Shuttle access and egress and mode 21 to represent MAGLEV.

Smart Shuttle is an itinerary-less, short distance, demand responsive transit service. To reflect this in the SCAG model, the mode was modeled as an access/egress mode to transit. The service was defined as an annulus around each station location with a minimum distance from the station of 0.5 mile, and a maximum distance of 4 miles. Since the maximum walk distance to a station is 0.5 mile, Smart Shuttle was not coded as a mode competing with walk access.

To represent the correct impedance to the mode choice model, each Smart Shuttle link was coded with a composite impedance for a wait time in minutes (Twait), in-vehicle time in minutes (Tivt), and cost in cents (Cost).

These times and costs were converted into impedance “utiles” by making use of the definition of the LOS (Level of Service) and the value of time (VoT) variables from the mode choice model. In the SCAG mode choice model, each minute of out-of-vehicle time (wait time) is counted as 2.5 times more onerous than a minute of in-vehicle time. The VoT is one-fourth the average wage rate for the traveler.

Table G-20

Transit Mode Definition Comparison					
"Old" SCAG Model	Mode #	"New" SCAG Model	Mode #	Interim MAGLEV Model	Mode #
Side Walk Link (2-way)	**1**	Side Walk Link (2-way)	**1**	Side Walk Link (2-way)	**1**
Auto Access Link (1-way, Zone to PNR)	**2**	Auto Access Link (1-way, Zone to PNR)	**2**	Auto Access Link (1-way, Zone to PNR)	**2**
Walk Link to/from Zone (2-way)	**3**	Walk Ingress Link (1-way, Zone to Transit Network)	**3**	Walk Ingress Link (1-way, Zone to Transit Network)	**3**
		Walk - PNR to Transit (1-way)	**4**	Walk - PNR to/from Transit	**4**
		Walk Egress Link (1-way, Transit Network Zone)	**5**	Walk Egress Link (1-way, Transit Network Zone)	**5**
				Smart Shuttle Access Link (2-way, different impedances)	**6**
MTA Local Bus	**4**	MTA Local Bus	**11**	MTA Local Bus	**11**
Other Muni Local Bus	**5**	LA County Local Bus LA County Local and Shuttle Bus LA County Local Bus	**16** **17** **18**	LA County Local Bus LA County Local and Shuttle Bus LA County Local Bus	**16** **16** **16**
Express Bus (All Operators)	**6**	MTA Express Bus LA County Express Bus LA County Local Bus All Non-LA County Express Bus	**12** **14** **15** **20**	MTA Express Bus LA County Express Bus LA County Local Bus All Non-LA County Express Bus	**12** **14** **15** **20**
OCTA Local Bus	**7**	All Non-LA County Local Bus	**19**	All Non-LA County Local Bus	**19**
Rail (Metro Rail, Metrolink)	**8**	Metrolink Rail Urban Rail (MTA Metro Rail)	**10** **13**	Metrolink Rail Urban Rail (MTA Metro Rail)	**10** **13**
MAGLEV	**9**			MAGLEV	**21**

Auto travel times between the station and each zone within the Smart Shuttle service annulus were determined and used as bases for determining Smart Shuttle in-vehicle travel times. Since Smart Shuttles might not offer direct service from a zone to the station serving the zone (e.g., they might stop to pick up an additional passenger), in-vehicle times were factored by 1.4. Remembering that there 100 cents/dollar, and 60 minutes/hour, impedance utiles were posted on each Smart Shuttle link as equivalent walk time using the formula:

$$
\begin{aligned}
\text{WalkTime} &= [(T_{wait}*2.5)+(T_{ivt}*1.4)+(Cost/100)\ /(VoT/60)]/2.5 \\
&=[(T_{wait}*2.5)+(T_{ivt}*1.4)+(Cost/100)\ / \\
&\{[Income/(4*2080)]/60\}/2.5 \\
&=[(T_{wait}*2.5)+(T_{ivt}*1.4)+(Cost*4992/Income)]/2.5
\end{aligned}
$$

Assuming a cost of 50 cents for the trip (1989 dollars) and an average wait of 5 minutes, this yields:

$$
\begin{aligned}
\text{WalkTime} &= [(12.5)+(T_{ivt}*1.4)+(249600/Income)]/2.5 \\
&=5+(T_{ivt}*0.56)+(99840/Income)
\end{aligned}
$$

Since the Smart Shuttle access/egress links are modeled as walk links, the path-builder weights them by a factor of 2.5. Thus, the posted “walk time” for Smart Shuttle impedance was divided by 2.5 before posting the value on each link.

Fare Structure

The base fare policy for the EA alignment is shown in Table G-21. This base fare policy, a $10 boarding fare with a $4 zone fare for the peak period, and $6 boarding fare with a $3 zone fare for the off-peak period, was used as the fare policy for all alternative alignment runs.

For the travel forecasts, fares were discounted to account for passes, multi-ride tickets, and employer subsidies of employer fares. The discounts were based on the current Metrolink system discounts and employer subsidies reported by current Metrolink riders. These discounts were 33 percent for the peak period and 20 percent for the off-peak period (i.e., base peak period fares were multiplied by 0.67 and off-peak period fares were multiplied by 0.80).

In addition to the various discounts, fares were converted from 1997 dollars to 1989 dollars based on the ratio of the Consumer Price Indices for those two years, 1.247 (i.e., fares in 1997 dollars were divided by 1.247 to represent fares in 1989 dollars). Based on the discounts and conversion to 1989 dollars, the base peak period boarding fare was $5.37 and the zone fare was $2.15; the base off-peak period boarding fare was $3.85 and the zone fare was $1.92.

Metrolink, express bus, and local bus fares were modeled in accordance with the current fare structure. The current fare structure is assumed to remain intact in 2020. The peak Metrolink boarding fare in 1989 dollars was $1.94 and zone fares varied from

Table G-21

MAGLEV Fare Structure – Base EA Alignment
(in 1997 Dollars)

	Peak	Off-Peak
Base Fare for Initial Boarding	$10.00	$6.00

Station-to-Station Zone Fare

Station	Peak	Off-Peak
LAX	$4.00	$3.00
Union Station	$4.00	$3.00
City of Industry	$4.00	$3.00
Ontario	$4.00	$3.00
Riverside	$4.00	$3.00
March Inland Port	$0.00	$0.00

PEAK PASSENGER FARES
In 1997 Dollars
EA Alignment

Peak	March Inland Port	Riverside	Ontario	City of Industry	Union Station	LAX
LAX	$26.00	$26.00	$22.00	$18.00	$14.00	X
Union Station	$22.00	$22.00	$18.00	$14.00	X	$14.00
City of Industry	$18.00	$18.00	$14.00	X	$14.00	$18.00
Ontario	$14.00	$14.00	X	$ 14.00	$ 18.00	$ 22.00
Riverside	$10.00	X	$14.00	$ 18.00	$ 22.00	$ 26.00
March Inland Port	X	$10.00	14.00	$ 18.00	$ 22.00	$ 26.00

OFF-PEAK PASSENGER FARES
In 1997 Dollars
EA Alignment

Peak	March Inland Port	Riverside	Ontario	City of Industry	Union Station	LAX
LAX	$18.00	$18.00	$15.00	$12.00	$9.00	X
Union Station	$15.00	$15.00	$12.00	$9.00	X	$9.00
City of Industry	$12.00	$12.00	$9.00	X	$9.00	$12.00
Ontario	$9.00	$9.00	X	$9.00	$12.00	$15.00
Riverside	$6.00	X	$9.00	$12.00	$15.00	$18.00
March Inland Port	X	$6.00	$9.00	$12.00	$15.00	$18.00

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$0.54 to $3.24. The peak period boarding fare for express buses was $0.66 and the boarding fare for local buses was $0.37. No zone fares were charged for express and local buses.

Table G-21 compares fares for MAGLEV and Metrolink for two interchanges. As can be seen in the table, the based MAGLEV fares were roughly 2.5 to 3 times the Metrolink fares for an interchange.

Table G-21

Comparison of Example MAGLEV and Metrolink Fares In 1989 Dollars

Interchange	MAGLEV Fare	Metrolink Fare
Riverside to Union Station	$11.82	$ 4.84
City of Industry to Union Station	$ 7.52	$ 2.67

Mode Choice Model Structure

The proper modeling of MAGLEV ridership in an urban setting such as the Los Angeles region provided a distinct challenge. The recently developed SCAG mode choice models employ many of the “best” state-of- the-practice techniques used in the standard “four-step” travel modeling process. However, since the SCAG travel data collection and model development processes could not, obviously, take into account the effects of MAGLEV on travel in the region, the models required modification to account for this new travel mode.

Reasonable forecasts of future MAGLEV ridership are most impacted by the regional mode choice model. The SCAG mode choice models represent “best” state-of-the-practice mode choice modeling techniques and were estimated using data collected as part of a regional travel survey conducted in 1991. Two different model forms, multinomial logit and nested logit, have been used for the mode choice models by trip purpose as follows:

- ü Home-based work–nested logit
- ü Home-based school–nested logit
- ü Home-based other–nested logit
- ü Work-based other–multinomial logit
- ü Other-based other–nested logit

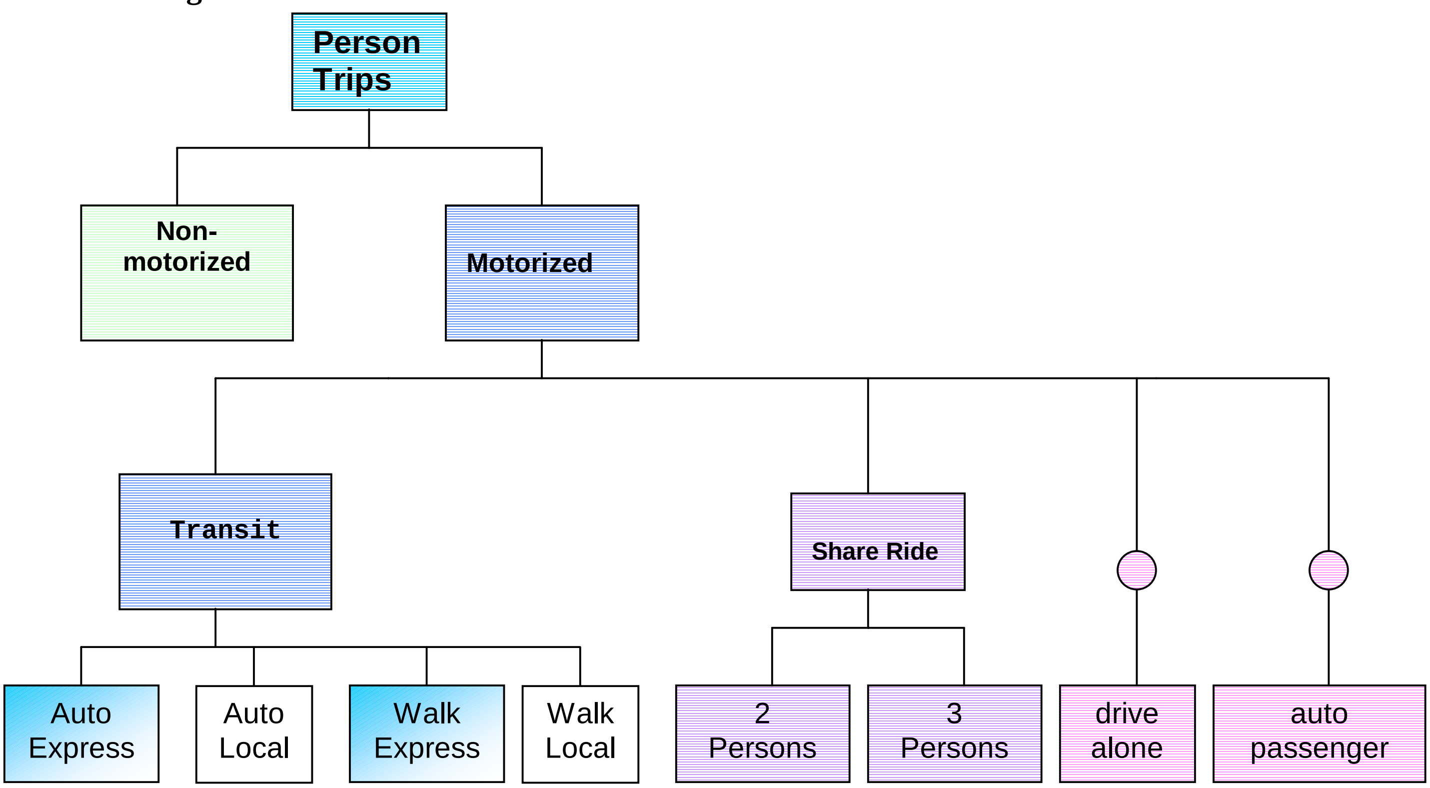
Nested logit models represent the current best state-of-the-practice for mode choice modeling and multinomial logit models are still considered “good” modeling practice.

Nested logit mode choice models offer an improvement over multinomial logit models. Multinomial logit models assume equally competing alternatives that allow shifting of trips to and from other modes in proportion to the initial estimates of those modes. A common problem that results from this proportional shifting is the violation of the Independence of Irrelevant Alternatives (IIA) axiom. Specifically, if an irrelevant alternative such as a “red” bus is introduced on an interchange served by blue buses and autos, the red bus will shift riders proportionately from both the blue buses and the auto.

Nested logit models account for other than equal (or proportional) competition among modes. For example, the structure for the SCAG home-based work mode choice model (Figure G-4) assumes that modes and submodes are distinctly different types of alternatives that present distinct choices to travelers. Within each nest, the model operates on the modes included in the nest as a multinomial logit model. Likewise, the model operates on nests included at a specific nesting level as a multinomial logit model. However, the competition between modes included in different nests or nesting levels is not in proportion to the initial estimates of the mode shares.

As a result, an important departure from multinomial logit models is that lower level choices are more elastic than they would be in a multinomial logit model. Using the “red

Figure G- 1



bus, blue bus" example from above, the nested logit structure would cause the new red bus to shift proportionately more riders from blue buses than from autos (assuming that the red bus would be entered as a new mode at the same level as the blue bus). Some riders would be shifted from autos to transit (red buses and blue buses, combined) due to service improvements, but the major shifts in mode use would be between competing submodes (red buses and blue buses). In application, utilities are estimated at the bottom levels first and passed up through the nesting structure. When this is complete, the probabilities are estimated from the top of the structure down. Composite utilities are passed upward through the use of "logsum" variables. These composite utilities are the natural logarithms of the denominators of the logit model.

The nesting coefficient is a calibrated value that lies in the range of 0 to 1. A value of 1 implies that the modes are completely different and that the nesting is not necessary (the modes should compete at a higher level in the nesting structure). A value of 0 implies that the modes are complete substitutes for each other. In practice, if a nested mode choice model was rigorously estimated using the red bus, blue bus example from above, the nesting coefficient for the red bus, blue bus nest should be found to be 0, since there would be no real difference between the buses.

While the existing SCAG mode choice models were rigorously estimated, they had to be modified to provide forecasts of MAGLEV ridership. The proper nesting structure for including MAGLEV in the SCAG regional mode choice models was a question that had to be answered before "investment grade" travel forecasts could be made. Three options were identified:

ü *Option 1.* Include MAGLEV and Express (Premium) transit as submodes under a premium transit mode (Figure 5-6?). Under this scenario, MAGLEV riders would be drawn first and foremost from other express transit modes, secondarily from local transit modes, and thirdly from other nontransit modes.

ü *Option 2.* Include MAGLEV as a separate mode under transit (Figure 5-7?). Under this option, MAGLEV would be modeled as a transit submode in the same manner as express transit (such as Metrolink) and local bus service. Under this scenario, MAGLEV riders would be drawn first and foremost from other transit modes, and secondarily from nontransit modes.

ü *Option 3.* Include MAGLEV as a separate motorized mode at the same level as transit, shared ride, auto passenger, and drive alone (Figure 5- 8?). In this scenario, MAGLEV riders would be drawn proportionately from transit, shared ride auto, auto passenger, and auto modes.

The Option 1 structure suggests that MAGLEV is simply another fixed guideway transit mode. It would be perceived by travelers to be transit with simply different operating characteristics—higher travel speeds and fewer transit stops. If this is, in fact, the way travelers perceive MAGLEV, the Option 1 structure is the proper structure for reducing the IIA problem.

The Option 3 structure suggests that MAGLEV is so drastically different from what is currently perceived as transit (or shared ride, auto driver, or auto passenger) that it is not even considered as a subset of that mode. The Option 2 structure suggests that, while MAGLEV would be perceived as a transit submode, it would be perceived as being different from current express or local transit modes.

The Option 1 nesting structure was the original structure suggested in the proposed work program for the MAGLEV study. However, the Metrolink and employee-based revealed and stated preference surveys provided an indication that Option 3 might be a better mode choice model structure.

Specifically, most Metrolink riders indicated that their previous mode for the trip was auto, not other transit. On the other hand, in the employee survey, many auto users and local or express bus users indicated that they would not switch modes under the various stated preference scenarios.

In order to obtain information on the best nesting structure, the stated preference data from the Metrolink and employee surveys were used to develop two ALOGIT [1] model estimation data sets. These data sets were used to test the three nesting structures along with a multinomial structure for the mode choice model. The alternative nesting structures were tested using each data set to ensure that consistent results would be obtained. In the primary tests, model coefficients were constrained to those used for the new SCAG home-based work mode choice model. The only coefficients that were not constrained within the ALOGIT runs were the alternative specific constants and the nesting coefficients.

The results suggested that Option 3 is the best nesting structure. ALOGIT was able to estimate model constants for the multinomial and Option 3 mode choice model structures. Based on log-likelihood values output as part of the model summaries, the Option 3 model was substantially better than the multinomial model. ALOGIT was not able to estimate models for either the Option 1 or Option 2 nesting structures.

Consistent results were obtained for both model estimation data sets. It should be noted that conclusions drawn from the statistical analyses were not completely conclusive. For both model estimation data sets, the models with the coefficients constrained to the SCAG model coefficients were inferior to models that included only alternative specific constants (this information is a standard output of ALOGIT). While this result was somewhat disconcerting, it was probably more a function of the Metrolink and employee surveys and the processing of the stated preference data from those surveys (to create the estimation data sets) than error in the specification of the regional models. To test this hypothesis, the models were run in an unconstrained manner. Simplified models based only on the level of service (LOS) variables and constants were specified. The level of service variable in the SCAG mode choice model is estimated as follows:

$$LOS = (IVTT + 2.5 * OVTT + Cost/VOT)$$

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where:

IVTT is in-vehicle travel time
OVTT is out-of-vehicle travel time
Cost is the travel cost
VOT is the value of time.

For the three income groups, the following values of time resulted for the midpoints of the income groups (in 1989 dollars):

Low: $1.34/hour
Middle: $4.25/hour
High: $10.25/hour

The above values of time were estimated as 25 percent of the average annual incomes divided by 2080.

To test the hypothesis that the processing of the stated preference data was causing the fully specified model to be inferior to a model with only alternative specific constants, ALOGIT was allowed to estimate the coefficients for the LOS variables and along with the constants and nesting coefficients. In this test, the fully estimated models were better than the models based only on alternative specific constants. Again, the only nested structure that could be estimated was the Option 3 structure; Option 1 and Option 2 structures failed in the estimation process.

The Option 3 structure nesting coefficient was almost 1.0 and the log-likelihood ratio for the Option 3 model was virtually identical to the multinomial structure. These results underscored those from the original model structure testing, specifically, that MAGLEV would be perceived to be a separate mode from transit.

The Drive to MAGLEV and Drive to Premium Transit alternative specific model constants from the constrained estimation are shown in Table G-23 for each of the estimation data sets. As can be seen, the MAGLEV constant is 15 percent to 24 percent greater than the Premium Transit model constants. Based on these results, it is suggested that the MAGLEV specific constants be set so that they are 20 percent "better" than the premium transit alternative specific constants. Table G-24 shows the calibrated premium transit alternative specific constants and the suggested MAGLEV alternative specific constants for the region.

Table G-23

Estimated Alternative Specific Constants				
Calibration Data Set	Premium Transit	MAGLEV	Difference	Percent Difference
Set 1	35.60	41.10	5.50	15.4%
Set 2	25.44	31.67	6.23	24.5%

Table G-24

Summary of Estimated, Calibrated, and Recommended Alternative Specific Constants					
Mode	Original CSI Estimate	Validated Constant		Recommended Constant	
		Peak	Off-Peak	Peak	Off-Peak
Non-Motorized	0.9057	0.8249	0.9089		
Drive Alone	–	–	–	–	–
Auto Passenger	-2.737	-3.104	-3.0824		
Shared Ride 2	-3.389	-3.3921	-3.3688		
Shared Ride 3+	-5.374	-5.5863	-5.5483		
Walk-Local	-2.375	+1.6043	+1.5859		
Drive-Local	-3.138	-2.2092	-1.7443	Same as Validated	Same as Validated
Walk-Express	-5.765	-2.8273	-3.1704		
Drive-Express	-5.446	-2.3297	-2.5687		
Walk-MAGLEV	N/A	N/A	N/A	-2.35608	-2.642
Drive-MAGLEV	N/A	N/A	N/A	-1.94142	-2.14058

The model coefficients for the level of service variable in the SCAG home-based mode choice model are as follows:

Low: -0.0165
Middle: -0.0210
High: -0.0373

If the above information is used to decompose the level of service coefficient and variable (shown previously) into component parts, the following utility equation fragments result for the midpoints of the income ranges:

Income Group	Model Coefficients		
	IVTT (per minute)	**OVTT (per minute)**	**Cost (per cent)**
Low	-0.0165	-0.0413	-0.007389
Middle	-0.0210	-0.0525	-0.002965
High	-0.0373	-0.0933	-0.000725

The above coefficients are all at the lowest level of the nesting structure. Based on the coefficients shown above, the equivalent "minutes saved" and "cost saved" for the improvements in the model constants for MAGLEV are shown in Table G-25.

Table G-25

Equivalent Savings from Differences in Alternative Specific Constants							
				Equivalent Savings in			
Time of Day	Mode Comparison	Constant Difference	Income Group	LOS	IVTT (minutes)	OVTT (minutes)	Cost (cents)
Peak	Walk to	0.4712	Low	28.56	28.56	11.41	63.8
	Express vs.		Middle	22.44	22.44	8.98	158.9
	Walk to		High	12.63	12.63	5.05	215.8
	MAGLEV						
Peak	Drive to	0.38828	Low	23.53	23.53	9.40	52.60
	Express vs.		Middle	18.49	18.49	7.40	131.0
	Drive to		High	10.41	10.41	4.16	177.80
	MAGLEV						
Off-Peak	Walk to	0.5284	Low	32.02	32.02	12.79	71.52
	Express vs.		Middle	25.16	25.16	10.06	178.23
	Walk to		High	14.17	14.17	5.66	242.01
	MAGLEV						
Off-Peak	Drive to	0.42812	Low	25.95	25.95	10.37	57.95
	Express vs.		Middle	20.39	20.39	8.15	144.41
	Drive to MAGLEV		High	11.48	11.48	4.59	196.08

An alternative approach for specifying alternative specific constants is to assume a reasonable equivalent time savings (or cost savings) represented by the mode at a point of indifference in terms of all other travel impedances. In other words, suppose a traveler was standing on a transit platform with two alternative modes such as Metrolink and MAGLEV on either side of the platform. Furthermore, both modes would provide exactly the same travel time to a destination at the same cost. Such a point would be the point of indifference. If there were no mode bias, the traveler would be equally likely to use either mode. However, if there were a mode bias, it might be expressed as the traveler perceiving a time (or cost savings) on one of the modes. For example, if the difference between the express constants and the MAGLEV constants were to represent an eight-minute time savings, the differences in the constants by income level would be as follows:

Low 0.132
Middle 0.168
High 0.298

The recommended differences between MAGLEV and express transit alternative specific constants shown in Table G-25 might seem large when compared to the equivalent constant differences for the suggested eight minutes of equivalent time savings. However, the recommended changes to the MAGLEV constants are moderate compared to the travel time savings implied by differences between the other model constants. For example, without a prior knowledge of the model constants, it might seem reasonable to suggest that the difference between the constants for 2 and 3+ person carpools, or between the constants for walk to express and auto to express should also be equivalent to eight minutes of savings.

However, as can be seen in Table G-26, the equivalent time savings implied by the calibrated constants are substantially greater. The implied time savings for the differences between the walk to express and auto to express are about equal to the magnitudes of the differences suggested between the MAGLEV and express transit constants. The differences between the 2 and 3+ person autos are about 4.6 times the differences between the walk and auto to express modes. Thus, when taken in context, the alternative specific constants recommended for MAGLEV are very reasonable in comparison to the alternative specific constants for express transit.

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Table G-26

Equivalent Time Values of Differences in Calibrated Alternative Specific Constants				
	Peak	Equivalent Time Values (minutes)		
Mode	Constant	Low Income	Middle Income	High Income
Shared Ride 2	-3.3921	[redacted]	[redacted]	[redacted]
Shared Ride 3+	-5.5863	[redacted]	[redacted]	[redacted]
Difference	-2.1942	133	104	59
Walk to express	-2.8273	[redacted]	[redacted]	[redacted]
Auto to express	-2.3297	[redacted]	[redacted]	[redacted]
Difference	-0.4976	30	24	13

Similar adjustments to nesting structures and mode choice model alternative specific constants were made for the other trip purposes. Table G-27 summarizes the express and MAGLEV constants for the non-work trip purposes. Since express transit was not considered a viable mode for home-based school trips (elementary and high school, not university), MAGLEV was not considered a viable mode for those trips, either.

Peer Review Panel Comments

Review of modeling procedures and results by a panel of experts *(see Appendix A of the full MAGLEV Report*) familiar with the region, travel demand forecasting, and/or high-speed rail was part of the quality control/quality assurance procedures used for the study. The peer review panel provided numerous useful comments regarding the modeling process and procedures that resulted in changes to the modeling process.

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Table G-27

Mode Choice Constants for Nonwork Trip Purposes			
Purpose	Mode	Constants	
		Peak	Off-Peak
Home-Based Other	NonMotorized	-0.551	-0.7966
	Drive Alone	0	0
	Auto Passenger	-0.6598	-0.7821
	Shared Ride 2	-1.1763	-1.1903
	Shared Ride 3+	-2.6394	-2.847
	Transit: Walk -Local	0.0298	-32255
	Transit: Walk -Express	-1.9292	-1.3211
	Transit: Auto - Local	-6.1037	-6.2339
	Transit: Auto - Express	-2.9037	-2.4738
	MAGLEV- Walk	-1.60767	-1.10092
	MAGLEV-Auto	-2.41975	-2.0615
Home-Based School	NonMotorized	3.1	1.8359
	Auto Passenger	0	0
	School Bus	1.2301	0.5602
	Transit: Walk -Local	5.8056	1.2729
	Transit: Auto - Local	0.5395	-2.4676
	MAGLEV-Walk	Not available	Not available
	MAGLEV-Auto	Not available	Not available
Other-Based Other	NonMotorized	-1.5101	-1.4845
	Drive Alone	0	0
	Auto Passenger	-0.7551	-0.9354
	Shared Ride 2	-2.1894	-2.2576
	Shared Ride 3+	-2.7888	-3.0037
	Transit: Walk	-5.3076	-4.5366
	MAGLEV- Walk	-4.423	-3.7805
Work-Based Other	NonMotorized	-1.9969	-1.0265
	Drive Alone	0	0
	Auto Passenger	-2.0988	-1.4292
	Shared Ride 2	-2.6163	-2.1008
	Shared Ride 3+	-3.7141	-2.89
	Transit: Walk	-4.9721	-5.2172
	Transit: Auto	-6.611	-8.4514
	MAGLEV- Walk	-4.14342	-4.34767
	MAGLEV-Auto	-5.50917	-7.04283

YEAR 2020 FORECASTS OF RIDERSHIP AND REVENUES

Overview

The Phase I ridership forecasts for the various alignments and station options range from 56,000 to 99,000 daily boardings for a year 2020 horizon timeline. Forecasts were performed for a wide variety of alignment and station options and for a range of headways, fare levels and service options. In addition, forecasts were produced under a number of different model assumptions to test the full effect of MAGLEV on competing modes and for market penetration. A series of forecasts were done with the existing regional mode choice model structure. A second round of forecasts was produced using a new mode choice structure, described in Section 5, that is based on MAGLEV market research. It allowed MAGLEV to more directly compete with automobile travel and produces slightly higher forecasts for year 2020.

Patronage Forecasts for Alternatives

As described in Section 5, the regional travel demand model maintained by SCAG has been used to produce MAGLEV patronage forecasts for residents of the region. As with any forecasting effort, there was some uncertainty associated with the 2020 travel forecasts for MAGLEV. To bound this uncertainty, two alternative travel forecasts were prepared for each MAGLEV alternative. The first travel forecast assumed that the high-speed MAGLEV line was an express transit mode. This approach assumed that express bus on a busway, Metrolink commuter rail and Metrorail, and MAGLEV are all the same generic mode: fixed guideway transit with limited stops at designated stations. This approach assumes that the only differences affecting passenger use can be described by operating characteristics (i.e., travel speeds, headways, and stop locations) and fares. The first travel forecast provided a lower bound on MAGLEV ridership for each alignment alternative.

The second travel forecast employed the mode choice component modified to include MAGLEV as a specific travel mode. This modeling approach assumed that MAGLEV was sufficiently different from any existing transit mode to consider it to be a new nontransit mode. The second travel forecast provided an upper bound on MAGLEV ridership for each alignment alternative.

Table G-28 summarizes the specific assumptions and changes to the modeling process and programs used in producing the 2020 MAGLEV travel forecasts.

Table G-28

Assumptions and Changes to Regional Modeling Process for 2020 Forecasts	
Model Component	Assumption of Change
Trip Generation	∉# 2020 socioeconomic and demographic data used for 2020 RTP formed basis for trip generation ∉# 2020 data aggregated to 1,555 zone structure
Trip Distribution	∉# MAGLEV added as a travel option affecting trip distribution (through composite impedance measure) for home-based work ∉# Trip distribution for other trip purposes based on assigned 2020 travel speeds (consistent with process used for 2020 RTP)
Mode Choice	∉# Two projections performed for each alternative: - A projection using the original mode choice model structure and assuming that MAGLEV is simply another express transit line - A projection using the revised mode choice model structure that includes MAGLEV as a separate mode from "transit"
Time-of-Day of Travel	∉# No changes from regional travel demand modeling process used for 2020 RTP.
Trip Assignment	∉# Consistent with assignment process used for 2020 RTP using MAGLEV as an "express transit" line or a separate mode, depending on mode choice modeling option employed

Trip Distribution Impacts

The new SCAG regional travel models employ best state-of-the-practice techniques for trip distribution, specifically, the use of the logsum variable from mode choice to represent travel impedance for interchanges. The logsum variable is the denominator of the logit equation and, thus, represents the contribution of all travel modes to the accessibility between zones. The use of the logsum solves the problem of trip distribution not being sensitive to the addition of major new transit systems such as a new rail line or MAGLEV line. Based on previous travel modeling practices where trip distribution is based on roadway impedances only, the addition of such a new major transportation facility has only minor, indirect impact on trip distribution through changes in travel speeds on the roadway network.

This best state-of-the-practice technique is used for home-based work trip distribution; trip distributions for the home-based school, home-based other, work-based other, and other-based other trip purposes employ the prior state-of-the-practice techniques.

The use of a composite impedance variable such as the logsum variable, adds a logical consistency to the trip distribution process: *If a significant proportion of the travelers on an interchange use a mode other than auto, their impedance on the interchange should be represented by that mode, not aut*o. However, while the use of composite impedance provides a logical consistency to the process, it complicates the analysis of the impacts of a new transportation facility. This complication occurs since the addition of a new facility affects not only mode choice, but also the number of travelers with that choice.

Since the transportation system for a region is a closed system, any increases in the number of trips on one interchange will cause a decrease in the numbers of trips on one or more other interchanges. Thus, when a new facility is added, the use of that facility increases more than what might be expected due to simple mode shifts since there will be more travel on the interchanges served by the facility. Conversely, travel on other, seemingly unrelated facilities will decrease simply since there are fewer trips on the interchange (mode shares should remain similar, but trips decrease).

Table G-29 shows the effects of the MAGLEV system on trip distribution. It summarizes linked trips from the corridor to other locations in the corridor. The corridor for this summary was defined as the area connected by auto access to the MAGLEV stations. The specific corridor districts were defined starting with the LAX station and moving eastward. Any zones not assigned to a station more westward on the MAGLEV line were assigned to each station as long as they were within the drive access-shed of the station. Thus, the corridor is coarsely defined and trips to a district within the corridor might not actually be within walk egress distances of a MAGLEV station.

As can be seen in Table G-29, the impact of the MAGLEV line and the nesting structure on trip distribution is substantial. For peak period home-based work trips, the MAGLEV substantially increases the number of trips from the corridor to the CBD/Central Area when the new nesting structure is used. Since the system is a closed system, corridor trips to other (non-CBD) locations in the corridor decrease. For off-peak period trips, there tends to be a decrease in the number of intracorridor trips even though the MAGLEV system has been added. While this change was somewhat unexpected, it could be a result of the interactions of roadway speeds with the trip distribution.

That trips to the CBD and LAX areas decreased for a number of the alternatives when the original nesting structure was used suggests that the addition of the MAGLEV line reduced the service provided in the corridor. In the original nesting structure, the determination of express transit or MAGLEV for each interchange was made based on the total travel time. However, the mode choice model included fare in the determination of the logsum variable for trip distribution.

Since modeled MAGLEV fares were substantially higher than Metrolink fares, the modeled accessibility for some interchanges that used MAGLEV decreased in comparison to the no project alternative. This result is counterintuitive and shows that simply using the original SCAG nesting structure to model MAGLEV produces some undesirable results. While the trip distribution using the new nesting structure is, possibly, overly sensitive to the MAGLEV line, the results are generally as should be expected.

In past studies, the analysis difficulties caused by allowing trip tables to vary by alternative (due to different modal alternatives and roadway network speeds) were avoided by fixing the trip tables used for analysis. Trip tables used for analyses of all alternatives were typically the trip tables forecast using the TSM network alternative. This allowed the mode choice impacts of the transportation alternative to be isolated. For the MAGLEV study, such an approach has been used to further understand the projected ridership on the MAGLEV system by using the trip tables resulting from the no-build alternative as the basis for the estimation of trips for two of the MAGLEV alternatives.

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Table G-29

Trip Distribution Impacts of MAGLEV System

			Alternative 1	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Time of Day	Trip Purpose	Linked Trips Corridor to:	Original Nesting	Original Nesting	New Nesting	Original Nesting	New Nesting	Original Nesting	New Nesting	Original Nesting	New Nesting
Peak	Home- Based Work	CBD / Central Area	609,546	603,732	618,850	608,035	619,724	610,531	617,437	609,963	620,527
		LAX Area	789,767	792,166	780,077	787,713	783,487	788,724	781,581	787,499	784,274
		Other Corridor Area	2,012,944	1,999,491	1,998,046	2,001,118	1,999,593	1,996,887	2,002,140	2,000,724	1,992,789
	Non-Work	CBD / Central Area	1,601,309	1,600,765	1,605,386	1,600,272	1,605,644	1,600,350	1,603,509	1,602,918	1,605,438
		LAX Area	2,153,749	2,150,209	2,152,953	2,147,273	2,154,091	2,149,496	2,154,363	2,148,816	2,154,070
		Other Corridor Area	6,547,523	6,562,942	6,543,684	6,572,198	6,539,529	6,566,534	6,541,982	6,569,720	6,539,777
	Total Trips	CBD / Central Area	2,210,855	2,204,497	2,224,236	2,208,307	2,225,368	2,210,881	2,220,946	2,212,881	2,225,965
		LAX Area	2,943,516	2,942,375	2,933,030	2,934,986	2,937,578	2,938,220	2,935,944	2,936,315	2,938,344
		Other Corridor Area	8,560,467	8,562,433	8,541,730	8,573,316	8,539,122	8,563,421	8,544,122	8,570,444	8,532,566
Off-Peak	Home- Based Work	CBD / Central Area	287,884	266,773	266,508	266,870	267,338	267,568	266,752	266,578	266,652
		LAX Area	338,344	338,451	335,367	338,425	335,149	338,301	335,551	339,260	335,143
		Other Corridor Area	888,514	888,327	886,159	888,628	885,277	887,971	885,182	887,997	884,645
	Non-Work	CBD / Central Area	1,651,917	1,652,775	1,652,169	1,653,378	1,654,404	1,652,301	1,653,100	1,653,904	1,652,769
		LAX Area	2,367,381	2,366,419	2,364,823	2,366,389	2,365,184	2,366,761	2,364,667	2,366,689	2,362,963
		Other Corridor Area	6,974,025	6,968,945	6,970,340	6,970,297	6,969,604	6,971,363	6,970,831	6,970,504	6,969,958
	Total Trips	CBD / Central Area	1,939,801	1,919,548	1,918,677	1,920,248	1,921,742	1,919,869	1,919,852	1,920,482	1,919,421
		LAX Area	2,705,725	2,704,870	2,700,190	2,704,814	2,700,333	2,705,062	2,700,218	2,705,949	2,698,106
		Other Corridor Area	7,862,539	7,857,272	7,856,499	7,858,925	7,854,881	7,859,334	7,856,013	7,858,501	7,854,603
Daily	Home- Based Work	CBD / Central Area	897,430	870,505	885,358	874,905	887,062	878,099	884,189	876,541	887,179
		LAX Area	1,128,111	1,130,617	1,115,444	1,126,138	1,118,636	1,127,025	1,117,132	1,126,759	1,119,417
		Other Corridor Area	2,901,458	2,887,818	2,884,205	2,889,746	2,884,870	2,884,858	2,887,322	2,888,721	2,877,434
	Non-Work	CBD / Central Area	3,253,226	3,253,540	3,257,555	3,253,650	3,260,048	3,252,651	3,256,609	3,256,822	3,258,207
		LAX Area	4,521,130	4,516,628	4,517,776	4,513,662	4,519,275	4,516,257	4,519,030	4,515,505	4,517,033
		Other Corridor Area	13,521,548	13,531,887	13,514,024	13,542,495	13,509,133	13,537,897	13,512,813	13,540,224	13,509, 735
	Total Trips	CBD / Central Area	4,150,656	4,124,045	4,142,913	4,128,555	4,147,110	4,130,750	4,140,798	4,133,363	4,145,386
		LAX Area	5,649,241	5,647,245	5,633,220	5,639,800	5,637,911	5,643,282	5,636,162	5,642,264	5,636,450
		Other Corridor Area	16,423,006	16,419,705	16,398,229	16,432,241	16,394,003	16,422,755	16,400,135	16,428,945	16,387,169

Linked Trips by Mode

Linked trips by mode provide a measure of the overall effectiveness of a mode in serving regional travel. Linked trips represent travel from each origin to each destination. Since several modes can be used on such a trip, a modal hierarchy is used to determine the primary mode. For example, for a trip from Burbank to LAX, a traveler might walk to a local bus stop, ride a local bus to a Metrolink station, ride Metrolink to Union Station, ride the MAGLEV to LAX, and walk to their final destination. While such a trip would use a number of modes, it would be considered a MAGLEV trip. Boardings by mode, or unlinked trips, are summarized in a subsequent section. The linked trip example described above would result in one boarding on local transit (local bus), one boarding on express transit (Metrolink), and one boarding on MAGLEV.

Table G-30 summarizes linked trips by express transit and MAGLEV modes for each of the alternatives. Forecasts for both the original and the revised mode choice models are shown. For the original mode choice model structure, where MAGLEV is considered an express transit mode (designated “Original Nesting” in Table G-30), it is impossible to summarize MAGLEV trips separately from express transit trips. Thus, when comparing forecasts from the revised mode choice model (designated “Revised Nesting” in Table G-30) with the original mode choice model, the express transit and MAGLEV trips should be combined. As can be seen in Table G-30, the number of daily linked trips on express transit modes in the region (including MAGLEV) varies between about 269,800 for Alternative 4 and about 278,500 for Alternative 2, based on the original mode choice model structure. The daily linked trips on express transit are forecast to be between 314,800 for Alternative 3 and 336,800 for Alternative 5 using the revised model structure.

As can be seen from these results, the *original nesting* structure suggests that the increased speed of the MAGLEV will not provide sufficient total savings (travel time and access time) to overcome the increased cost represented by the base fare structure. The result would be a loss of riders on the combined express transit/MAGLEV mode. While the MAGLEV would attract significant numbers of riders (see Sections 6.1.4 and 6.1.5), the net loss in total express transit ridership is illogical and shows that simply using the original nesting structure for the model is incorrect. There would be no reason for travelers to quit riding existing express transit modes in the corridor simply because MAGLEV was added at a higher fare. These results also suggest that the original base fare structure for MAGLEV was too high.

The revised mode choice nesting structure provides a substantially different picture of the future. Specifically, MAGLEV would attract substantial numbers of “new” trips from other, nontransit modes. Using the year 2020 No Project alternative, Alternative 1, as a base, Alternative 3 (with the lowest number of combined trips on express transit and MAGLEV) is forecast to attract about 18,300 new trips daily. The 18,300 new trips come from new trips drawn to the corridor from other destinations and nontransit modes.

Table G-30 **Linked Trips by Transit and MAGLEV Modes**

Time of Day	Trip Purpose	Mode	Alternative 1 Original Nesting	Alternative 2 Original Nesting	Alternative 2 New Nesting	Alternative 3 Original Nesting	Alternative 3 New Nesting	Alternative 4 Original Nesting	Alternative 4 New Nesting	Alternative 5 Original Nesting	Alternative 5 New Nesting
Peak	Home-Based Work	Express Transit	137,404	123,963	127,002	121,129	126,425	117,312	123,854	117,739	126,295
		Maglev	-	-	11,005	-	9,252	-	11,415	-	16,724
		Total	137,404	123,963	138,007	121,129	135,677	117,312	135,269	117,739	143,019
	Non-Work	Express Transit	42,800	41,960	41,948	41,756	41,609	41,387	41,612	41,787	42,165
		Maglev	-	-	10,388	-	10,655	-	13,974	-	16,114
		Total	42,800	41,960	52,336	41,756	52,264	41,387	55,586	41,787	58,279
	Total Trips	Express Transit	180,204	165,923	168,950	162,885	168,034	158,699	165,466	159,526	168,460
		Maglev	-	-	21,393	-	19,907	-	25,389	-	32,838
		Total	180,204	165,923	190,343	162,885	187,941	158,699	190,855	159,526	201,298
Off-Peak	Home-Based Work	Express Transit	32,638	29,818	30,188	29,360	29,927	29,151	29,823	28,792	29,983
		Maglev	-	-	3,760	-	3,317	-	4,284	-	5,841
		Total	32,638	29,818	33,948	29,360	33,244	29,151	34,107	28,792	35,824
	Non-Work	Express Transit	83,631	82,752	81,313	82,590	81,116	81,962	80,571	82,256	81,226
		Maglev	-	-	12,257	-	12,498	-	17,198	-	18,568
		Total	83,631	82,752	93,570	82,590	93,614	81,962	97,769	82,256	99,794
	Total Trips	Express Transit	116,289	112,570	111,501	111,950	111,043	111,113	110,394	111,048	111,209
		Maglev	-	-	16,017	-	15,815	-	21,482	-	24,409
		Total	116,289	112,570	127,518	111,950	126,858	111,113	131,876	111,048	135,618
Daily	Home-Based Word	Express Transit	170,042	153,781	157,190	150,489	156,352	146,463	153,677	146,531	156,278
		Maglev	-	-	14,765	-	12,569	-	15,699	-	222,565
		Total	170,042	153,781	171,955	150,489	168,921	146,463	169,376	146,531	178,843
	Non-Work	Express Transit	126,431	124,712	123,261	124,346	122,725	123,349	122,183	124,043	123,391
		Maglev	-	-	22,645	-	23,153	-	31,172	-	34,682
		Total	126,431	124,712	145,906	124,346	145,878	123,349	153,355	124,043	158,073
	Total Trips	Express Transit	296,473	278,493	280,451	274,835	279,077	269,812	275,860	270,574	279,669
		Maglev	-	-	37,410	-	35,722	-	46,871	-	57,247
		Total	296,473	278,493	317,861	274,835	314,799	269,812	322,731	270,574	336,916

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Combined with the 17,400 trips drawn from the express transit mode produces about 35,700 linked trips on MAGLEV. If Alternative 1 is compared with Alternative 5 (with the highest number of combined trips on express transit and MAGLEV), about 16,800 trips on MAGLEV are drawn from the express transit mode and 40,400 trips are from new trips drawn to the corridor from other destinations and nontransit modes.

A number of alternative model runs were made using the EA alignment. The model runs tested the sensitivity of the model with respect to different headways and fares, and also responded to questions posed by the peer review panel. Table G-31 summarizes the mode choice model results. Alternative 1, the no project alternative, and Alternative "2m," the EA alignment alternative with 5 minute headways and the base fare structure, are shown bases for comparison. All results, except those for Alternative 1, are based on the model using the new nesting structure. Brief descriptions of the alternative runs and results are provided below.

Table G-31

Summary of Mode Choice Model Results

Time of Day	Trip Purpose	Mode:	Alternative 1	Alternative 2m	5 Minute Headways							20 Minute Headway		
						Revised Constants						Revised Constants		
					Original Constants (Alt 2m0)	w/ Parking Costs (Alt 2mp	No Smar Shuttle (Alt 2ms	No LAX Station (Alt 2mu	5 Min Walk @ Station (Alt 2mw	Uses Alt 1 Trip Table (Alt 2mbl	20 Minute Headway (Alt 2mh	Alternate Fares 1 (Alt 2mhf2)	Alternate Fares 2 (Alt 2mhf3)
Peak	Home- Based Work	Express Transit	137,404	127,002	128,654	122,560	128,540	127,970	121,512	129,771	129,211	122,638	122,782
		MagLev	-	11,005	7,861	5,184	9,389	7,364	8,666	9,242	9,134	20,300	14,904
		Total	137,404	138,007	136,515	127,744	137,929	135,334	130,178	139,013	138,345	142,938	137,686
	Non-Work	Express Transit	42,800	41,948	41,878	39,446	41,799	42,015	39,330	41,914	41,925	41,824	41,884
		MagLev	-	10,388	5,793	8,749	9,705	3,367	8,863	10,372	7,344	10,444	10,427
		Total	42,800	52,336	47,671	48,195	51,504	45,382	48,193	52,286	49,269	52,268	52,311
	Total Trips	Express Transit	180,204	168,950	170,532	162,006	170,339	169,985	160,842	171,685	171,136	164,462	164,666
		MagLev	-	21,393	13,654	13,933	19,094	10,731	17,529	19,614	16,478	30,744	25,331
		Total	180,204	190,343	184,186	175,939	189,433	180,716	178,371	191,299	187,614	195,206	189,997
Off-Peak	Home- Based Work	Express Transit	32,638	30,188	30,461	28,890	30,073	30,452	28,671	30,197	30,383	30,019	30,122
		MagLev	-	3,760	2,589	1,593	3,265	2,380	2,814	3,307	3,207	4,417	3,294
		Total	32,638	33,948	33,050	30,483	33,338	32,832	31,485	33,504	33,590	34,436	33,416
	Non- Work	Express Transit	83,631	81,313	81,327	77,173	81,026	81,489	77,127	81,189	81,350	81,212	81,249
		MagLev	-	12,257	8,105	10,199	11,688	4,918	10,408	12,016	10,539	12,175	12,097
		Total	83,631	93,570	89,432	87,372	92,714	86,407	87,535	93,205	91,889	93,387	93,346
	Total Trips	Express Transit	116,269	111,501	111,788	106,063	111,099	111,941	105,798	111,386	111,733	111,231	111,371
		MagLev	-	16,017	10,694	11,792	14,953	7,298	13,222	15,323	13,746	16,592	15,391
		Total	116,269	127,518	122,482	117,855	126,052	119,239	119,020	126,709	125,479	127,823	126,762
Daily	Home- Based Work	Express Transit	170,042	157,190	159,115	151,450	158,613	158,422	150,183	159,968	159,594	152,657	152,904
		MagLev	-	14,765	10,450	6,777	12,654	9,744	11,480	12,549	12,341	24,717	18,198
		Total	170,042	171,955	169,565	158,227	171,267	168,166	161,663	172,517	171,935	177,374	171,102
	Non-Work	Express Transit	126,431	123,261	123,205	116,619	122,825	123,504	116,457	123,103	123,275	123,036	123,133
		MagLev	-	22,645	13,898	18,948	21,393	8,285	19,271	22,388	17,883	22,619	22,524
		Total	126,431	145,906	137,103	135,567	144,218	131,789	135,728	145,491	141,158	145,655	145,657
	Total Trips	Express Transit	296,473	280,451	282,320	268,069	281,438	281,926	266,640	276,037	283,071	282,869	275,693
		MagLev	-	37,410	24,348	25,725	34,047	18,029	30,751	34,937	30,224	47,336	40,722
		Total	296,473	317,861	306,668	293,794	315,485	299,955	297,391	318,008	313,093	323,029	316,759
Daily Trips on MAGLEV	Home-Based Work	From Express	-	12,852	10,927	18,592	11,429	11,620	19,859	10,074	10,448	17,385	17,138
		From Other	-	1,913	(477)	(11,815)	1,225	(1,876)	(8,379)	2,475	1,893	7,332	1,060
		Total MAGLEV	-	14,765	10,450	6,777	12,654	9,744	11,480	12,549	12,341	24,717	18,198
	Non-Work	From Express	-	3,170	3,226	9,812	3,606	2,927	9,974	3,328	3,156	3,395	3,298
		From Other	-	19,475	10,672	9,136	17,787	5,358	9,297	19,060	14,727	19,224	19,226
		Total MAGLEV	-	22,645	13,898	18,948	21,393	8,285	19,271	22,388	17,883	22,619	22,524
	Total Trips	From Express	-	16,022	14,153	28,404	15,035	14,547	29,833	13,402	13,604	20,780	20,436
		From Other	-	21,388	10,195	(2,679)	19,012	3,482	918	21,535	16,620	26,556	20,286
		Total MAGLEV	-	37,410	24,348	25,725	34,047	18,029	30,751	34,937	30,224	47,336	40,722

Original Constants (Alt 2m0)	This model run of the EA Alignment was requested by the peer review panel to test the sensitivity of the forecasts to the alternative specific constants specified for MAGLEV (see Section 5). The model run was identical to Alternative 2m with the exception of the model constants. Total daily trips on MAGLEV were forecast to be about two-thirds of the trips forecast for Alternative 2m.
With Parking Costs at Stations (Alt 2mp)	This alternative was requested by the peer review panel to test the sensitivity of the forecasts to the imposition of parking costs at MAGLEV stations. The model run was identical to Alternative 2m with the exception that $5.00 parking costs (in 1989 dollars, $6.24 in 1997 dollars) were imposed at the stations. This alternative reduced the forecast daily MAGLEV trips to about 70 percent of the trips forecast for Alternative 2m. The imposition of the $5.00 parking costs caused a net loss in total express transit and MAGLEV trips forecast in comparison to Alternative 1.
No Smart Shuttle Service to MAGLEV Stations (Alt 2ms)	This alternative was requested by the peer review panel to test the sensitivity of the forecasts to the Smart Shuttle service provided to MAGLEV stations. The model run was identical to Alternative 2m with the exception that no Smart Shuttle service to the MAGLEV stations was provided. The removal of the Smart Shuttle service had relatively little impact on ridership, decreasing total MAGLEV ridership to about 91 percent of the ridership forecast for Alternative 2m. These results suggest that Smart Shuttle users will switch to auto access to MAGLEV if the Smart Shuttle service is not provided.
No MAGLEV Service to LAX Provided (Alt 2mu)	This alternative tested the impact of removing MAGLEV service to LAX. The model run was identical to Alternative 2m with the exception that no MAGLEV service to LAX was provided. The impact on forecast MAGLEV ridership was substantial, reducing the total forecast trips to 48 percent of the forecast for Alternative 2m.
5 Minute Walk at MAGLEV Stations (Alt 2mw)	This alternative was requested by the peer review panel to test the sensitivity of the forecasts to the estimated walk time from park-and-ride lots to MAGLEV stations. The model run was identical to Alternative 2m with the exception that the walk time from park-and-ride lots to the MAGLEV station was increased from one minute to five minutes. The four minute increase in walk time reduced the forecast MAGLEV trips to about 82 percent of the forecast for Alternative 2m.
Use Alternative 1 Trip Tables	This alternative was requested by the peer review panel to test the sensitivity of the forecasts to the input person trip tables. The

(Alt 2mb1)	person trip tables resulting from the trip distribution for Alternative 1 were used as input to the mode choice model. No modifications to the distributions were allowed via feedback loops. The model run was identical to Alternative 2m in all other aspects. The use of the Alternative 1 trip tables as the bases for mode choice had relatively little impact on the forecast MAGLEV ridership, decreasing trips to about 93 percent of the forecast for Alternative 2m.
20 Minute Headway (Alt 2mh)	This alternative tested the impact increasing the MAGLEV headway from 5 minutes to 20 minutes on MAGLEV ridership. Due to construction costs for a two-track MAGLEV line, the likelihood of a one-track line with passing tracks was very high. The minimum headway that could be run on such a system was 20 minutes. With the exception of the revised headway, the model run was identical to Alternative 2m. The modified headways reduced the forecast MAGLEV trips to about 81 percent of the forecast for Alternative 2m.
Alternative Fare Structure 1 (Alt 2mhf2)	This alternative tested the impact of an alternative fare structure on MAGLEV ridership, using the 20-minute headway operating policy. the boarding fare for this structure was increased from a $5.35 to $6.00 (in 1989 dollars). However, zone fares were reduced substantially from $2.15 to $0.50. The modified fare structure with the modified headways increased the forecast MAGLEV trips by about 27 percent over the forecast for Alternative 2m.
Alternative Fare Structure 2 (Alt 2mhf3)	This alternative tested the impact of an alternative fare structure on MAGLEV ridership, using the 20-minute headway operating policy. The boarding fare for this structure was increased from a $5.35 to $8.00 (in 1989 dollars). However, zone fares were reduced substantially from $2.15 to $0.50. Except for the revised fare structure, the model run was identical to Alternative 2m. The modified fare structure with the modified headways increased the forecast MAGLEV trips by about 9 percent over the forecast for Alternative 2m.

Daily Passenger Boardings

The ridership forecasts for the various alignments and station options range from 56,000 to 99,000 daily passenger boardings for a year 2020 horizon timeline. Early forecasts were performed with the existing mode choice model that yielded forecasts in the lower to middle portion of this range. The range is due to the variations in number of stations in the alignments and in the markets served. A second round of forecasts has

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now been produced using a new mode choice structure that is based on MAGLEV market research. It allows MAGLEV to more directly compete with automobile travel and produces a higher range of ridership (66,000 to 99,000 daily boardings for 2020).

To fully understand markets and market shares, MAGLEV ridership forecasts were prepared for multiple MAGLEV alternatives (and a no-build alternative) using various fare and operational configurations. Table G-31 summarizes Year 2020 projected total daily MAGLEV boardings for the EA Alignment. Total projected daily riders vary between 57,000 and 88,000 in Year 2020 for the EA Alignment Alternative, depending on fare and modeling assumptions.

Table G-32

Project Ridership in the Year 2020
EA Alignment Alterntive

Trip Type	Range in MAGLEV Ridership[a]	Total Daily Trips in Corridor	Percent Market Share
Long–distance Commute to Work	16,000 – 32,000	700,000	2% – 5%
Long–distance Resident Non–work	10,000 – 16,000	1,000,000	1% – 2%
Air Passengers (LAX–Ontario	24,000 – 26,000	300,000	8% – 9%
Airport–March Inland Port)			
Special Events/Special Generator	4,000 – 10,000	200,000	2% – 5%
Visitors			
Induced Passenger Trips	3,000 – 4,000	N/A	N/A
Total	**57,000 – 88,000**	**2,200,000**	**3% – 4%**

[a] Assumes a 20-minute headway. Range in ridership is due to different fare and modeling

Table G-32 shows the extent to which the EA Alignment is expected to penetrate various travel purpose markets. The journey-to-work trip is expected to capture the largest share of total riders—between 16,000 and 32,000—followed closely by air passengers—24,000 to 26,000. Non-work related trips by residents comprise the third largest group of riders— between 10,000 and 16,000 MAGLEV riders.

Table G-32 also shows, for the various trip purposes, the percentage range of travel market share for MAGLEV of all trips in the corridor. MAGLEV achieves a range in total travel market share of from 3 to 4 percent, with the highest individual market share of 9 percent for air passengers.

The number of MAGLEV passengers was also determined for individual segments (station-to-station). In general, the largest number of year 2020 MAGLEV passenger are projected to ride between the San Gabriel Valley station and Union Station, and between Union Station and LAX. Higher ridership in these areas is to be expected, given that these stations serve the most densely populated and largest activity centers in the corridor. Based on modeling results, the average MAGLEV passenger trip lengths vary from 43.2 to 52.8 km (27 to 33 miles). These lengths clearly indicate that MAGLEV will be most attractive for longer trips in the corridor. Market shares; confirm this as shown in Table G-32, for long-distance commute and nonwork trips.

Table G-33 summarizes the total daily passenger boardings on MAGLEV for a typical weekday in year 2020 using the original mode choice nest in the regional travel model.

Table G-33

Original Mode Choice Nesting				
(Modeled at 5 Minute Peak/10 Minute Off-Peak Headways) (Total Daily Boardings)				
Trip Type	EA Alignment Alt. 2C	Mid Corridor I-210 Alt. 3C	Mid Corridor I-10 Alt. 4C	EA Alignment plus West LA Alt. 5C
Peak Periods	19,000	21,000	27,000	32,000
Off-Peak	14,000	10,000	16,000	20,000
Air Passengers	28,000	20,000	24,000	25,000
Special Events	6,000	6,000	6,000	6,000
Induced Trips	3,000	2,000	3,000	3,000
Total Boardings	70,000	59,000	76,000	86,000
This series of runs was performed using the Standard Fare Schedule shown in Section 5 of this report.				

As shown in Table G-33, the total number of daily passenger boardings on MAGLEV alternatives 2 through 5 varies by category of travel market. The highest ridership is produced by Alternative 5 (EA Alignment with a station in West Los Angeles). This alternative has a total of seven stations, compared with six for the other three alternatives analyzed in this section. Alternative 5 has a station near the I–10/I–405 interchange and penetrates the West Los Angeles/Santa Monica to downtown Los Angeles travel market not served by other MAGLEV alternatives. This market contains a large number of commute trips as well as many non-work trips defined for downtown Los Angeles. Since no other commuter rail line is planned to connect this area with downtown Los Angeles in the future, MAGLEV would complete with local and express bus as well as automotive modes. MAGLEV also attracts trips from West Los Angeles to the LAX–El Segundo area. El Segundo has a large concentration of jobs in technology and aerospace.

As shown in Table 4-1? in Section 4, Alternative 5 (with West Los Angeles) is 144 km (90 miles) long versus the 131 km (82-mile) candidate alternative. With the extra mileage and a seventh station, its capital and operating costs will exceed that of the EA Alignment (Alternative 2). A cost-benefit analysis is being performed to compare the extra costs against gains in ridership and passenger revenues.

As shown in the table, forecasts of air passenger ridership vary for the alternatives from a high of 28,000 daily trips for the EA Alignment to 20,000 for Alternative 3. The variation in air passenger ridership is largely caused by differences in airport-to-airport travel times between LAX and Ontario International Airports. For example, Alternative 3

(I–210 corridor) adds an extra 11 minutes in travel time between Ontario Airport and LAX versus the EA Alignment.

Table G-34 summarizes the total daily boardings on MAGLEV using the newly expanded mode choice model. Because the expanded mode choice model allows MAGLEV to compete more directly with automotive modes, it results in somewhat higher MAGLEV ridership for commute-to-work and resident nonwork trips. As was the case with required travel model forecasts using the original mode choice nest, Alternative 5 (EA Alignment plus a station in West Los Angeles) achieves the highest ridership of any of the alternatives tested.

Table G-34

Preliminary Ridership Forecasts for Project Horizon
Year 2020 with Expanded Mode Choice Nesting
(Total Daily Passenger Boardings)

Modeled at 5 Minute Peak/10 Minutes Off-Peak Headways

Trip Type	Model Runs of Alternatives using the Standard Fare Schedule				Fare Sensitivity Runs of the EA Alignment (Alt. 2M)	
	EA Alignment Alt. 2MC	Mid Corridor I-210 Alt. 3MC	Mid Corridor I-10 Alt. 4MC	EA Alignment plus West LA Alt. 5MC	2mf2c	2mf3c
Peak Periods	21,000	28,000	25,000	32,000	26,000	21,000
Off-Peak	15,000	15,000	21,000	24,000	15,000	14,000
Air Passengers	28,000	20,000	24,000	25,000	28,000	28,000
Special Events	6,000	6,000	6,000	6,000	6,000	6,000
Induced Trips	3,000	2,000	3,000	4,000	3,000	3,000
Total Boardings	73,000	71,000	79,000	91,000	78,000	72,000

Modeled at 20 Minute Headways Throughtout the Day

Trip Type	Runs of EA Alignment using Standard Fare Schedule		Fare Sensitivity Runs of the EA Alignment (Alt. 2M)		
	EA Alignment Alt. 2mhc	EA Alignment plus West LA Alt. 5MC	2mhfc	2mhf2c	2mhf3c
Peak Periods	16,000	32,000	32,000	23,000	17,000
Off-Peak	12,000	18,000	16,000	12,000	11,000
Air Passengers	26,000	24,000	26,000	26,000	26,000
Special Events	6,000	6,000	10,000	6,000	5,000
Induced Trips	2,000	3,000	4,000	3,000	2,000
Total Boardings	62,000	77,000	70,000	70,000	61,000

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Passenger and Total Revenues

Table G-35 shows preliminary forecasts of annual passenger revenues for horizon year 2020 for the various the MAGLEV alternatives analyzed in this report. Different annualization factors were used to convert daily revenues to annual revenues for the different trip purposes. For commuters, 255 was used while for other nonwork purposes 340 was appropriate. 365 was used for air passengers, special events trips, and induced riders since they occur 7 days a week for every week of the year. As shown in the table, annual passenger revenues range from $240 million for Alternative 3 using the original mode choice nest to $350 million for Alternative 5 using the expanded mode choice nest. The passenger revenues shown in the table are based on the fare assumptions described in Section 5.

Table G-35

Passenger Revenue Annualized for Horizon Year 2020		
Forecasts of MAGLEV	Annual Passenger Revenues ($million)	
Alternative	Original Nest	Expanded Nest
2 – EA MAGLEV Alignment	290	320
3 – Mid-Corridor (I-210)	240	260
4 – Mid-Corridor (*-10)*	290	320
5 – Selected plus West Los Angeles	300	350

Passenger revenues are expected to provide the majority of the revenue streams for the MAGLEV Project. However, other streams of revenues are expected from a variety of other sources once the line begins operations. As shown in Table G-36, these include:

Table G-36

Total Annual Revenues Forecast for MAGLEV – for Year 2020	
	Range of Estimates (In Millions of Dollars)
1. Annual Passenger Revenues	$290 - $320
2. Annual Freight and Cargo Revenues	$6 - $7
3. Annual Station Parking Revenues	$7 - $8
4. Annual Station Concessions and Joint Development	$43 - $44
Total Revenues	$346 - $379

Other Operating Revenues

Parking

Parking revenues will be generated at MAGLEV stations as a result of charging user fees. The number of parking spaces required to support 2020 ridership levels for the candidate project was used to estimate parking revenues. Annual parking revenue in that year is estimated to be $7.6 million. Spaces will be added as ridership grows beyond 2020 levels; fee increases may also be instituted, with the result that revenues are projected to grow at around 6 percent a year.

Parking revenues in the first years of MAGLEV operation reflect lower demand. In 2010 annual revenues will be approximately $4.2 million.

Concessions and Joint Development

Concessions (advertising, services, retail and other activities) at and in the vicinity of MAGLEV stations will generate lease/franchise and related revenues for system operations. Joint development opportunities are also expected to generate ongoing revenues for the MAGLEV project. In 2020, revenues from concessions and joint development combined are estimated to total approximately $43.4 million. As system operations expand, revenues grow from around $23.8 million in 2010 to $74.5 million in 2045.

Freight

MAGLEV presents a significant opportunity to move goods quickly and reliably in a highly congested urban travel environment. MAGLEV service would allow for on-board goods shipment for which user fees would be charged. The revenue potential is highly variable and potentially considerable; however, a conservative, moderate level of freight revenue has been assumed in the benefits analysis. In 2020, freight movement is expected to generate on the order of $6.2 million in annual MAGLEV operating revenue. By 2045, this would grow to $7.9 million, a modest increase. The combined MAGLEV operating revenues from these sources is estimated to be $365.3 million in 2020. Of that amount, riders' fares would be the largest revenue source, around 85 percent.

Average Fare and Average Fare per Passenger Mile

Table G-37 shows average passenger fares and average revenues per passenger mile for the MAGLEV Alternatives (with and without the new Mode Choice nest) for forecast year 2020. As shown, average passenger fares range between $9.84 for the EA Alignment with a reduced fare schedule to $15.14 for the EA Alignment with a high fare schedule. By comparison, the Metrolink commuter rail system reported an average passenger fare of $4.18 for fiscal year 1997–1998. Thus, MAGLEV fares are 2.7 times higher than Metrolink, on average.

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Table G-37 also shows average fare (passenger revenue) per passenger mile for the MAGLEV alternatives in year 2020. Fares and revenues that are shown in the revenue tables are in constant 1997 dollars. As shown, the average fare per passenger mile ranges from $0.32 for Alternative 3M, to $0.41 for Alternative 5M. Alternative 5M has a seventh station in West Los Angeles and this market generates trips of moderate length (10-12 miles to downtown Los Angeles and the LAX-El Segundo area.

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Table G-37

Average Passenger Fares and Average Revenues per Passenger Mile for 2020 MAGLEV Alternatives

All Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2c	69,676	$ 307,888,945	23,008,017	702,909,001	30.55	$13.38	$0.44
5c	87,701	$ 337,713,971	27,963,153	771,672,710	27.60	$12.08	$0.44
2mc	73,327	$ 317,169,704	24,067,913	714,680,949	29.69	$13.18	$0.44
3mc	63,489	$ 260,667,136	20,654,412	648,459,754	31.40	$12.62	$0.40
4mc	78,896	$ 318,036,705	25,526,942	678,888,739	26.59	$12.46	$0.47
5mc	91,570	$ 346,607,913	29,259,719	783,026,724	26.76	$11.85	$0.44
2mhc	62,971	$ 282,290,451	20,939,851	647,269,750	30.91	$13.48	$0.44
5mhc	78,204	$ 306,045,511	25,195,448	697,213,705	27.67	$12.15	$0.44
2mf2c	78,227	$ 330,577,423	25,325,170	790,024,343	31.20	$13.05	$0.42
2mf3c	72,490	$ 356,013,382	23,754,356	727,692,020	30.63	$14.99	$0.49
2mhfc	88,413	$ 278,063,180	28,268,160	929,320,366	32.88	$9.84	$0.30
2mhf2c	70,556	$ 302,894,509	22,955,868	735,554,319	32.04	$13.19	$0.41
2mhf3c	62,171	$ 310,350,503	20,495,254	643,036,962	31.37	$15.14	$0.48

Peak Daily Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2c	18,900	$ 59,820,878	4,819,551	135,950,317	28.21	$12.41	$0.44
5c	32,187	$ 91,118,926	8,207,787	185,513,937	22.60	$11.10	$0.49
2mc	21,078	$ 63,947,758	5,374,865	131,325,818	24.43	$11.90	$0.49
3mc	28,489	$ 57,699,972	4,982,471	120,446,144	24.17	$11.58	$0.48
4mc	25,062	$ 74,426,462	6,390,759	138,630,256	21.69	$11.65	$0.54
5mc	32,454	$ 90,297,336	8,275,745	169,832,853	20.52	$10.91	$0.53
2mhc	15,928	$ 48,749,554	4,061,538	105,436,687	25.96	$12.00	$0.46
5mhc	26,278	$ 73,167,170	6,700,839	137,960,939	20.59	$10.92	$0.53
2mf2c	25,939	$ 69,368,711	6,614,547	195,889,249	29.61	$10.49	$0.35
2mf3c	21,410	$ 73,908,577	5,459,601	150,892,103	27.64	$13.54	$0.49
2mhfc	31,842	$ 52,474,594	8,119,710	262,538,205	32.33	$6.46	$0.20
2mhf2c	22,636	$ 60,667,860	5,772,206	178,386,743	30.90	$10.51	$0.34
2mhf3c	17,441	$ 60,389,878	4,447,481	128,832,530	28.97	$13.58	$0.47

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Average Passenger Fares and Average Revenues per Passenger Mile for 2020 MAGLEV Alternatives (Contd)

Offpeak Daily Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2c	13,784	$ 38,958,910	4,686,662	102,207,185	21.81	$8.31	$0.38
5c	20,287	$ 53,079,265	6,897,410	130,541,345	18.93	$7.70	$0.41
2mc	15,118	$ 43,674,034	5,139,984	118,182,412	22.99	$8.50	$0.37
3mc	14,784	$ 41,839,043	5,026,492	117,570,182	23.39	$8.32	$0.36
4mc	20,535	$ 58,023,842	6,982,002	142,682,692	20.44	$8.31	$0.41
5mc	23,740	$ 62,439,881	8,071,702	157,324,175	19.49	$7.74	$0.40
2mhc	11,701	$ 34,072,396	3,978,374	96,808,213	24.33	$8.56	$0.35
5mhc	18,332	$ 48,469,987	6,232,880	123,367,857	19.79	$7.78	$0.39
2mf2c	14,967	$ 52,414,583	5,088,780	124,974,157	24.56	$10.30	$0.42
2mf3c	13,981	$ 63,615,980	4,753,438	110,822,956	23.31	$13.38	$0.57
2mhfc	16,061	$ 24,487,421	5,460,808	151,606,953	27.76	$4.48	$0.16
2mhf2c	12,286	$ 43,118,838	4,177,240	107,506,578	25.74	$10.32	$0.40
2mhf3c	11,146	$ 50,791,186	3,789,470	93,070,477	24.56	$13.40	$0.55

Air Passenger Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2c	27,821	$ 171,436,602	10,154,813	341,302,992	33.61	$16.88	$0.50
5c	25,364	$ 153,605,645	9,257,917	321,189,216	34.69	$16.59	$0.48
2mc	27,821	$ 171,436,602	10,154,813	341,302,992	33.61	$16.88	$1.83
3mc	20,234	$ 124,681,165	7,385,319	277,016,571	37.51	$16.88	$0.45
4mc	23,775	$ 146,500,369	8,677,750	277,675,701	32.00	$16.88	$0.53
5mc	25,364	$ 153,605,645	9,257,917	321,189,216	34.69	$16.59	$0.48
2mhc	26,430	$ 162,864,772	9,647,073	324,237,843	33.61	$16.88	$0.50
5mhc	24,096	$ 145,925,363	8,795,021	305,129,755	34.69	$16.59	$0.48
2mf2c	27,821	$ 171,436,602	10,154,813	341,302,992	33.61	$16.88	$0.50
2mf3c	27,821	$ 171,436,602	10,154,813	341,302,992	33.61	$16.88	$0.50
2mhfc	26,430	$ 162,864,772	9,647,073	324,237,843	33.61	$16.88	$0.50
2mhf2c	26,430	$ 162,864,772	9,674,073	324,237,843	33.61	$16.88	$0.50
2mhf3c	26,430	$ 162,864,772	9,674,073	324,237,843	33.61	$16.88	$0.50

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Average Passenger Fares and Average Revenues per Passenger Mile for 2020 MAGLEV Alternatives (Contd)

Special Events Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2c	6,490	$ 26,992,772	2,368,850	93,868,912	39.63	$11.39	$0.29
5c	6,490	$ 27,294,262	2,368,850	101,301,407	42.76	$11.52	$0.27
2mc	6,490	$ 26,992,772	2,368,850	93,868,912	39.63	$11.39	$0.29
3mc	6,490	$ 26,992,772	2,368,850	106,155,250	44.81	$11.39	$0.25
4mc	6,490	$ 26,992,772	2,368,850	91,085,422	38.45	$11.39	$0.30
5mc	6,490	$ 27,294,262	2,368,850	101,301,407	42.76	$11.52	$0.27
2mhc	6,490	$ 26,992,772	2,368,850	93,868,912	39.63	$11.39	$0.29
5mhc	6,490	$ 27,294,262	2,368,850	101,301,407	42.76	$11.52	$0.27
2mf2c	6,490	$ 25,761,591	2,368,850	93,868,912	39.63	$10.88	$0.27
2mf3c	6,490	$ 33,152,403	2,368,850	93,868,912	39.63	$14.00	$0.35
2mhfc	10,302	$ 26,783,584	3,760,079	148,998,272	39.63	$7.12	$0.18
2mhf2c	6,490	$ 25,761,591	2,368,850	93,868,912	39.63	$10.88	$0.27
2mhf3c	5,044	$ 25,763,847	1,840,913	72,948,687	39.63	$14.00	$0.35

Induced Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2c	2,680	$ 10,679,782	978,140	29,579,595	30.24	$10.92	$0.36
5c	3,373	$ 12,615,873	1,231,190	33,126,806	26.91	$10.25	$0.38
2mc	2,820	$ 11,118,539	1,029,401	30,000,815	29.14	$10.80	$0.37
3mc	2,442	$ 9,454,183	891,281	27,271,607	30.60	$10.61	$0.35
4mc	3,034	$ 12,093,259	1,107,582	28,814,669	26.02	$10.92	$0.42
5mc	3,522	$ 12,970,789	1,285,506	33,379,073	25.97	$10.09	$0.39
2mhc	2,422	$ 9,610,957	884,016	26,918,096	30.45	$10.87	$0.36
5mhc	3,008	$ 11,188,729	1,097,858	29,453,747	26.83	$10.19	$0.38
2mf2c	3,009	$ 11,595,936	1,098,180	33,989,033	30.95	$10.56	$0.34
2mf3c	2,788	$ 13,899,820	1,017,654	30,805,057	30.27	$13.66	$0.45
2mhfc	3,508	$ 11,452,810	1,280,490	41,939,093	32.75	$8.94	$0.27
2mhf2c	2,714	$ 10,481,448	990,500	31,554,245	31.86	$10.58	$0.33
2mhf3c	2,110	$ 10,540,820	770,318	23,947,424	31.09	$13.68	$0.44

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OPENING YEAR 2010 FORECASTS OF RIDERSHIP AND REVENUES

Overview

Our preliminary ridership forecasts for the EA alignment (Alternative 2) with six stations is 51,000 daily passenger boardings for a year 2010 opening year timeline. A shorter four-station segment of the EA alignment (LAX Airport to Ontario Airport) was also modeled for year 2010. Many other opening year phasing options have also been analyzed during Phase I of the Project. They include:

- ü Downtown Los Angeles to March Inland Port
- ü LAX to San Bernardino/Riverside
- ü LAX to downtown Los Angeles
- ü Variations of the above

All the candidates for startup phasing were analyzed from a cost, ridership, revenue, and operational feasibility perspective. If the project development process can proceed expeditiously, an opening year segment may be put into service as early as year 2008.

Table G-38 summarizes the total year 2010 daily passenger boardings on MAGLEV for the full six-station EA alignment using the expanded mode choice nest in the regional travel model runs. As was the case with 2020 forecasts, MAGLEV ridership is being forecast in 2010 for the 5 categories of ridership shown in Table G-38.The table also reports ridership for the four-station version of the EA alignment (LAX to Ontario) modeled in Phase I.

Table G-38

Preliminary Ridership Forecasts for Opening Year 2010 for the EA Alignment (Modeled with Expanded Mode Choice Nesting and 20-Minute Headways Throughout the Day)

Daily	Alternative	
Ridership	Six-Station LAX-March	Four-Station LAX-Ontario
Peak Period	14,000	11,000
Off-Peak Period	10,000	8,000
Air Passengers	20,000	17,000
Special Events	5,000	3,000
Induced	2,000	2,000
Total	51,000	41,000

2010 Ridership Forecast

As shown in Table G-38, ridership for the six-station EA alignment in year 2010 is 51,000. It is composed of peak period trips (primarily work, off-peak resident-based trips, air passenger trips, special event/special generator trips, and induced trips.

As shown in Table G-38, forecasts of air passenger ridership is 20,000 for opening year 2010. The variation in air passenger ridership in alternatives is largely caused by differences in airport-to-airport travel times. Alternative 3 (I–210 corridor) adds an extra 11 minutes in travel time between Ontario Airport and LAX versus the EA alignment

Table G-38 also shows ridership for a four-station version of the EA alignment from LAX to Ontario. It is forecast to carry 41,000 total daily passengers for an opening year 2010, many other phasing options.

Table G-39 shows the overall performance of the EA alignment for opening year 2010.As the table shows, the average trip length is approximately 30 miles for the six-station line.

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Table G-39

Overall Performance Summary for 2010 MAGLEV Alternatives

All Riders

Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2mh10c	50,892	$221,498,543	16,796,476	501,663,064	29.87	$ 13.19	$ 0.44
6mh10c	40,079	$173,896,426	13,241,735	365,585,668	27.61	$ 13.13	0.48

Peak Daily Riders

Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2mh10c	13,791	$ 41,095,106	3,516,578	82,397,093	23.43	$ 11.69	$ 0.50
6mh10c	10,779	$ 32,086,548	2,748,518	61,769,987	22.47	$ 11.67	0.52

Off-Peak Daily Riders

Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2mh10c	10,452	$ 30,337,146	3,553,544	84,784,326	23.86	$ 8.54	$ 0.36
6mh10c	8,052	$ 23,548,720	2,737,782	63,054,903	23.03	$ 8.60	0.37

Air Passenger Riders

Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2mh10c	19,823	$122,148,579	7,235,304	243,178,362	33.61	$ 16.88	$ 0.50
6mh10c	17,089	$102,702,207	6,237,407	197,502,103	31.66	$ 16.47	0.52

Special Events Riders

Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2mh10c	4,868	$ 20,244,579	1,776,638	70,401,684	39.63	$ 11.39	$ 0.29
6mh10c	2,618	$ 9,634,029	955,388	27,994,524	29.30	$ 10.08	0.34

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Induced Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2mh10c	1,957	$ 7,673,132	714,412	20,901,579	29.26	$ 10.74	$ 0.37
6mh10c	1,541	$ 5,924,922	562,641	15,264,151	27.13	$ 10.53	0.39

Table G-40 shows the mode of access to stations on the EA alignment for opening year 2010. As the table shows, auto access is used by the majority of passengers on both the six-station and four-station versions. Auto access ranges from 75 to 81 percent for the EA alignment.

Table G-40

Mode of Access to MAGLEV Stations for Year 2010 (for the Ridership Portion Forecast Using the Regional Travel Model)			
Alt 2mh10	Peak	Off-Peak	Total
Auto	10,404	8,177	18,581
	75%	78%	
Walk	3,387	2,275	5,662
	25%	22%	
Total	13,791	10,452	24,243
	100%	100%	

Alt 2mh10	Peak	Off-Peak	Total
Auto	8,460	8,549	17,009
	78%	81%	
Walk	2,419	1,573	3,992
	22%	19%	
Total	10,879	10,122	21,001
	100%	100%	

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Table G-41 shows daily parking demand for the four- and six-station versions of the EA alignment. The six-station line will require approximately 13,000 total parking spaces for opening year 2010.

Table G-41

Daily Parking Spaces Required at MAGLEV Stations for Year 2010		
Station	Total Daily Parking Spaces	
	Alt 2mh10c	Alt 6mh10c
LAX	1,972	1,953
West LA		
Union	2,631	2,625
Mid Corridor	2,676	2,723
Ontario	3,274	3,081
Riverside	900	
March	1,400	
Total	12,853	10,382

HORIZON YEAR 2045 FORECASTS OF RIDERSHIP AND REVENUES

Our preliminary ridership forecasts for the various MAGLEV alignments and station options range from 83,000 to 120,000 daily boardings for a Project horizon year 2045 timeline. These long-range MAGLEV ridership forecasts were performed by factoring year 2020 forecasts using the California Department of Finance (DOF) long-range growth rates described in Section 3 of this report. The range in forecasts is due to the variations in number of stations in the alignments and in the markets served.

A second round of forecasts is included that was factored from 2020 forecasts using a new mode choice structure based on MAGLEV market research. As described in Section 5, under this nesting, MAGLEV more directly competes with automobile travel and produces a higher range of ridership (99,000 to 128,000 daily boardings for project horizon year 2045.

Table G-42 summaries the total daily passenger boardings on MAGLEV from forecasts factored from 2020 projections to represent ridership for horizon year 2045. The forecasts shown in the table were produced using the original mode choice nest in the regional travel model.

As shown in Table G-42, the total number of daily passenger boardings on MAGLEV Alternatives 2 through 5 varies by travel market. As was the case in year 2020, the highest ridership is produced by Alternative 5 (EA alignment with a station in West Los Angeles). This alternative has a total of seven stations, compared with six for the other three alternatives analyzed in this section. Alternative 5 has a station near the I–10/I–405 interchange and penetrates the West Los Angeles/Santa Monica to downtown Los Angeles market not served by other MAGLEV alternatives. It also generates commuter, air passenger, and special events trips from West Los Angeles to the LAX–El Segundo area.

Table G-42

Preliminary Ridership Forecasts for Project Horizon Year 2045 with Original Mode Choice Nesting (Total daily boardings) (Modeled at 5 Minute Peak/10-Minute Off-Peak Headways)

Trip Type	EA Alignment	Mid-Corridor I-210	Mid-Corridor I-10	EA Alignment plus West Los Angeles
Commute-to-Work	27,000	30,000	38,000	35,000
Resident Non-Work	20,000	14,000	23,000	28,000
Air Passenger	39,000	28,000	34,000	35,000
Special Events/Special Generator Visitors	8,000	8,000	8,000	8,000
Induced Trips	4,000	3,000	4,000	4,000
Total	**98,000**	**83,000**	**107,000**	**110,000**

Note: Modeled Using the Standard Fare

The alignment for Alternative 5 is 144 km (90 miles) long versus the 131.2-km (82–mile) EA alignment. With the extra mileage and a seventh station, its capital costs exceed that of the EA alignment (Alternative 2). A cost-benefit analysis will be performed to compare the extra costs against gains in ridership and passenger revenues.

As shown in the table, forecasts of air passenger ridership vary for the alternatives from a high of 39,000 daily trips for the EA alignment to 28,000 for the Mid-Corridor alignment that runs along I–210. The variation in air passenger ridership is largely caused by differences in airport-to-airport travel times. Alternative 3 (I–210 corridor) adds an extra 11 minutes in travel time between Ontario International Airport and LAX versus the EA alignment.

Table G-43 summarizes the higher range of total daily boardings on MAGLEV for project horizon year 2045. These higher estimates were described using the California Department of Finance growth factors applied to the year 2020 modeled ridership using the newly expanded mode choice model. Because the expanded mode choice model allows MAGLEV to compete more directly with automotive modes, it results in higher MAGLEV ridership for commute-to-work and resident nonwork trips (17 to 39 percent increase varying by alternative). As was the case with forecasts using the original mode choice nest, Alternative 5 (EA alignment plus a station in West Los Angeles) achieves the highest ridership because it penetrates additional travel markets in West Los Angeles.

Table G-42

Preliminary Ridership Forecasts for the Project Horizon Year 2045 With Expanded Mode Choice Nesting

	Forecasts Assuming Standard Fare Schedule				EA Alignment Assuming Alternative Fares	
Trip Type	EA Alignment	Mid Corridor I-210	Mid Corridor I-10	EA Alignment plus West Los Angeles	Moderate Fares	Higher Fares
Commute-to-Work	30,000	39,000	35,000	45,000	37,000	30,000
Resident Non-Work	21,000	21,000	30,000	34,000	21,000	20,000
Air Passengers	39,000	28,000	34,000	35,000	39,000	39,000
Special Events/Special Visitor Generator	8,000	8,000	8,000	8,000	8,000	8,000
Induced Trips	4,000	3,000	4,000	6,000	4,000	4,000
Total	**102,000**	**99,000**	**111,000**	**128,000**	**109,000**	**101,000**

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Table G-44 shows parking estimates for year 2045 for the EA alignment under three different fare scenarios. Table G-45 shows a statistical summary of the performance of alternatives in year 2045.

Table G-43

Daily Parking Spaces Required at MAGLEV Stations for Year 2010			
Station	Total Daily Parking Spaces		
	Alt 2m45c	Alt 2m45f2c	Alt 2m45f3c
LAX	5,722	5,766	5,521
West LA			
Union	4,891	4,948	4,788
Mid Corridor	3,726	3,954	3,816
Ontario	6,222	6,661	6,150
Riverside	1.928	2,389	2,139
March	3,601	4,906	3,761
Total	26,091	28,624	26,176

Table G-44

Overall Performance Summary for 2010 MAGLEV Alternatives							
All Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2m45c	103,391	$447,209,283	33,935,757	1,007,700,138	29.69	$13.18	$0.44
2m45fc	110,299	$466,114,166	35,708,490	1,113,934,323	31.20	$13.05	$0.42
2m45f3c	102,211	$501,978,868	33,392,642	1,026,045,748	30.63	$14.99	$0.49
Peak Daily Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2m45c	29,720	$ 90,166,338	7,578,559	185,169,404	24.43	$11.90	$0.49
2m45f2c	36,575	$ 97,809,882	9,326,511	276,203,841	29.61	$10.49	$0.35
2m45f3c	30,188	$104,211,093	7,698,037	212,757,865	27.64	$13.54	$0.49

Off-Peak Daily Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2m45c	21,316	$ 61,580,387	7,247,377	166,637,201	22.99	$8.50	$0.37
2m45f2c	21,103	$ 73,904,562	7,175,180	176,213,561	24.56	$10.30	$0.42
2m45f3c	19,713	$ 89,698,532	6,702,348	156,260,369	23.31	$13.38	$0.57

Air Passenger Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2m45c	39,228	$241,725,609	14,318,287	481,237,219	$33.61	$16.88	$0.50
2m45f2c	39,228	$241,725,609	14,318,287	481,237,219	$33.61	$16.88	$0.50
2m45f3c	39,228	$241,725,609	14,318,287	481,237,219	$33.61	$16.88	$0.50

Special Events Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2m45c	9,151	$ 38,059,809	3,340,079	132,355,165	39.63	$11.39	$0.29
2m45f2c	9,151	$ 36,323,843	3,340,079	132,355,165	39.63	$10.88	$0.27
2m45f3c	9,151	$ 46,744,888	3,340,079	132,355,165	39.63	$14.00	$0.35

Induced Riders							
Alternative	Daily Ridership	Annual Revenue	Annual Ridership	Annual Passenger Miles	Average Trip Length (Miles)	Average Fare	Average Revenue Per Passenger Mile
2m45c	3,977	$ 15,677,140	1,451,455	42,301,149	29.14	$10.80	$0.37
2m45f2c	4,242	$ 16,350,270	1,548,434	47,924,537	30.95	$10.56	$0.34
2m45f3c	3,931	$ 19,598,747	1,434,892	43,435,130	30.27	$13.66	$0.45

Table G-45

Passenger Revenue Forecasts Annualized for Project Horizon Year 2045		
	Annual Passenger Revenues ($ Millions)	
Alternative	**Original Nest**	**Expanded Nest**
2 - EA Alignment	440	510

3 - Mid Corridor I-210	370	400
4 - Mid Corridor I-10	420	490
5 - EA Alignment plus West Los Angeles	450	530

RIDERSHIP FORECASTS AND BENEFITS

The benefits of a new and efficient travel mode like MAGLEV extend beyond the immediate, and perhaps most readily identifiable, advantages to users, who will (1) be able to make selected trips in the region on a very fast and reliable service and (2) pay fare revenues that are projected (at the project level at least) to cover all operating costs and a significant portion of system development costs. In addition, MAGLEV deployment will generate a number of other direct and indirect benefits that have great importance for the LAX-to-March Corridor and the entire southern California region. Among these other benefits are:

ü New opportunities to change the shape of urban development in a metropolis projected to grow by at least 30 percent in the next 20 years and possibly 80 percent over the next 45 years.

ü Less severe highway and airport congestion.

ü New travel mode opportunities and shifts in modal use.

ü Improvements in the capacity and reliability of goods movements.

ü Savings in energy consumption, improvements in air quality and various other environmental benefits.

In its study of the commercial feasibility of high-speed ground transportation in the United States *(High-Speed Ground Transportation for America,* U.S. Department of Transportation, Federal Railroad Administration, September 1997; or *HSG*T), the FRA set forth a methodology for evaluating the direct and indirect benefits of major passenger railroad investments. The study identified those benefits determined to be the most important in estimating the overall benefits/costs of a proposed program.

The California MAGLEV Deployment Project assesses project benefits using the FRA guidelines as the basic analytical framework. It looks at each of the benefits components and attempts to quantify relationships or, where quantification is not practicable, qualitatively describe impacts of the program. However, the benefits analysis also, extends the discussion to include certain benefits components not included in the FRA guidelines, broadening the umbrella, figuratively speaking, of relevant substantial impacts of MAGLEV implementation that warrant attention in this feasibility study. This is entirely appropriate, for the Los Angeles metropolitan region has certain unique characteristics and faces certain special problems (special in their magnitude if not in the critical nature) that could be overlooked in a generalized application of benefits/costs assessment.

The California MAGLEV Project Description (of June 30, 2000) describes project benefits in detail. The benefits assessment is summarized at both the project level and for the entire corridor. At this phase, there is considerably more detail on MAGLEV

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impacts, including benefits, at the project level, and therefore the discussion in this report focuses the travel benefits of the proposed project. A more general benefits discussion is included in the MAGLEV Project Description for MAGLEV implementation throughout the entire corridor.

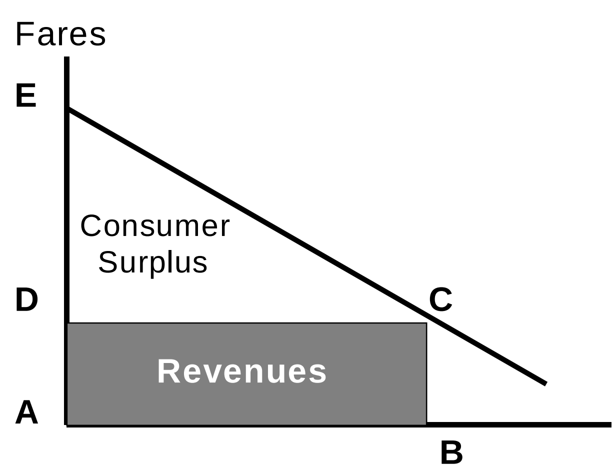
While some of the benefits components are transparent, a number warrant explanation. Benefits definitions and the methodology for calculating benefits are provided as the analysis results are reported for project-level impacts. No further explanatory material is provided in the discussion of benefits for MAGLEV deployment in the entire corridor.

User Benefits

Whereas the ridership and revenues associated with the project are clear user-generated benefits, an important additional benefit associated with MAGLEV riders is the users' consumer surplus. Consumer surplus is the difference between what a user is willing to pay for the service and what he or she actually must pay. (Freight and shipping users would also have a consumer surplus, but for this analysis, consumer surplus is defined and calculated only for riders of MAGLEV.) Although MAGLEV prices will be set to maximize revenues, this does not equate to charging each customer the maximum price he or she will tolerate to ride the system; that is simply not practicable even under sophisticated pricing by market segment. A number of passengers will be willing to pay more for the service they receive than the actual fare charged.

The difference between the price charged and the price a customer is willing to pay—the additional value of user benefits not captured by fares—is termed consumer surplus. Although not as directly and conveniently monetizable as are fares, consumer surplus can nonetheless be quantified and monetized by determining the demand curve for MAGLEV service, specifically in the area where demand exceeds the actual price charged for the service. This relationship is shown in Figure G-5. Point D is assumed to represent the baseline average fare paid by riders represented by point B. Fare revenue is equivalent to the area of the shaded rectangle ABCD, or AB times AD. Users' consumer surplus is represented by the triangular area CDE between the MAGLEV demand and price curves to the left of equilibrium point C—or where demand exceeds the baseline average fare.

Figure G-5



The estimation procedure involves establishing the basic shape, or slope, of the demand curve by performing certain sensitivity tests of demand for several alternative pricing levels. (In Figure G-5, demand is represented by the line segment EC extended, a simplification for illustration purposes.) For this study, a two-step approach was used to determine how ridership and revenues would vary at fares above the MAGLEV baseline fare.

The full SCAG ridership model, incorporating the EA alignment's service and fare characteristics, was run for a 50 percent change in fares. Aggregate fare elasticity values (quantifying the relationship of the estimated change in demand with respect to a change in fare) were then developed for the following trip types:

- Peak home-based work
- Peak nonwork
- Off-peak home-based work
- Off-peak nonwork

These trip categories were further disaggregated to provide elasticities for four trip lengths: short, medium, long, and regional.

A spreadsheet model of these relationships was used to evaluate incremental increases in the fare for each trip type, up to approximately three times the baseline fare. Results were analyzed for reasonableness, and it was determined that at high fare levels demand was too inelastic with respect to an incremental change in fares. Therefore, trend analysis based upon results of ridership changes for lower fare levels was used to establish a more reasonable and conservative approximation of the demand curve at high fares. The maximum fare (actually a composite fare for all trip types) that could be charged on the system before ridership trended to zero was on the order of $35, based upon trend analysis. This is roughly equivalent to point E in Figure 9-1.

The value of consumer surplus for the MAGLEV project in 2020 was calculated to be on the order of 129 percent of fare revenue. This is within the range of other studies that have estimated consumer surplus, although at the higher end of the scale.

To ensure a further conservative bias in the estimation of project benefits, consumer surplus was set not to exceed projected fare revenues in any single year. Based upon this assessment, consumer surplus for the California Project would be $310 million in 2020. In the first full year of MAGLEV service (2010), users' consumer surplus would be approximately $217 million. In the years beyond 2020, users' consumer surplus increases in proportion with fare revenues.

Benefits to the Public at Large

The benefits described above are received by, or at least associated with, MAGLEV users. Benefits that spill over to others—the public—are designated as benefits to the public at large or to society in general. Benefits to the public at large consist of potential reductions in the level of congestion, and thereby reduced travel delay, on other modes as well as a net reduction in the emissions of other modes. The two primary modes affected by a shift of travel to MAGLEV in the project study area are air travel and private motor vehicles, with a possible reduction in airport and roadway congestion, respectively. The main mode for which a reduction in emissions is anticipated is private motor vehicles, both autos and trucks. [As is explained here and in the MAGLEV Project Description, a shift in air travel among airports serving metropolitan Los Angeles is an anticipated effect of MAGLEV deployment; however, a substantial net reduction in air trips—and thereby takeoffs and landings at all airports—is not projected.]

Airport Congestion Delay Savings

The analysis focuses on conditions at the two major airports served by the California Project, LAX and Ontario International Airport.

Airport congestion is severe at LAX and will become increasingly so in the future. This congestion adds to airlines' operating costs and passengers' travel times whereas MAGLEV service offers the potential to reduce the congestion at LAX, by opening up alternate airports as substitute origins/destinations to LAX. The fast and convenient travel between LAX and Ontario International Airports will make Ontario International Airport increasingly attractive to airlines wishing to operate flights out of a location that is less congested, and thereby less expensive. Air passengers will see the trade-off of travel out of Ontario International Airport as opposed to LAX as less onerous and possibly representing a time savings, given the average delay per operation—i.e., a plane landing or taking off—projected for LAX in the near future.

Similarly, the potential to shift freight service or possibly air passenger service to a reuse field at March Inland Port (March Air Reserve Base) may be advantageous to some airlines and shippers. Operating costs for freight traffic could be reduced inasmuch as commercial freight service out of LAX faces many of the same delays as commercial passenger service. The final destination (off-airports) also has an effect on the airport selected.

For benefit-cost analysis, congestion delay savings attributable to MAGLEV are calculated for two airport users: commercial airlines and their passengers. Savings are quantified by estimating the changes in (1) operating costs of aircraft and (2) travel time savings for air passengers who remain at either airport when total takeoffs and landings are reduced at LAX as a result of shifting air passengers to Ontario International Airport. Because it is difficult at this preliminary stage to quantify the likely change in freight aircraft takeoffs and landings at LAX with MAGLEV service in place, the potential benefits for this mode have been excluded from the analysis. This adds a conservative bias to the estimation of monetary benefits of reducing airport congestion in the project study area.

The methodology for estimating delay savings follows generally that developed in the *HSGT Stud*y, with information on current and future airport activity updated from studies undertaken by the Los Angeles World Airports. A particularly important source of information on the effect of MAGLEV on both air passengers and aircraft operations is the Regional Airport Demand Model/RADAM Version 4.2 projection of 2020 conditions at LAX and Ontario International Airport, with and without connecting MAGLEV service. The forecast represents the RTP, medium growth scenario, prepared under the direction of the SCAG Aviation Task Force.

Under highly congested conditions, because each additional aircraft operation adds significantly to the average delay experienced by other aircraft attempting to land or take-off, reducing operations can also reduce the operating costs of other, remaining aircraft. The Federal Aviation Agency (FAA) and individual airports have estimated the average delay per operation in minutes and the corresponding cost to the average airline for various levels of annual aircraft operations at most major airports. For LAX and Ontario International Airport, delay relationships derived from this data and refined by the Volpe Center and Mitre Corporation for the *HSGT Study* were applied to projections of operations with and without MAGLEV service.

The marginal cost of major airline operations at major airports was estimated by the Volpe Center to be $40.62 per minute for large commercial jets and $12.35 per minute for smaller commuter aircraft in 1993. In the conversion from 1993 CFS, the 2000 values are approximately $48.29 and $14.68, respectively.

Passenger delay savings are directly related to the reduction in aircraft operations delay. When there are fewer takeoffs and landings at a congested airport such as LAX, the time saved per operation is the average time saved by passengers boarding and alighting the flights that continue to based there. Time saved is monetized using a value of time for air passengers developed in the *HSGT Stud*y, escalated to 2000 values. This is currently $46.40 per hour.

Because there is a projected shift of passengers and aircraft operations to Ontario International Airport with MAGLEV in use, congestion at Ontario International Airport would actually increase compared to the baseline condition. An increase in airline operating costs could result along with an increase in passenger wait times, and these disbenefits should be attributed to MAGLEV. The increase in congestion at Ontario for both the growth in passenger activity associated with baseline air traffic and the incremental growth due to MAGLEV diversions was determined to be small. Thus, the marginal effect of MAGLEV on aircraft operating costs and air passenger delay costs was also small. Nevertheless, the airport congestion delay analysis was based upon quantifying the net benefits of delay savings at LAX and delay increases at Ontario International Airport.

Table G-47 provides a summary of estimated airport congestion delay savings in 2020 for LAX and Ontario International Airport. Operations delay savings result from a shift of on the order of 47,000 aircraft operations from LAX to other regional airports, primarily Ontario International Airport, with MAGLEV service. This shift represents approximately 5.7 percent of the total baseline operations at LAX. The diversion of operations would lead to a reduction in average delay per remaining operation of approximately 2.7 minutes. The net timesavings monetized—for both LAX and Ontario International Airport, where a moderate increase in congestion costs is anticipated—is on the order of $62.3 million a year.

Passenger travel delay savings attributable to MAGLEV are significantly higher due to the large volumes of air travelers benefiting from lower LAX aircraft operations delay time. The number of annual air passengers decreases by approximately 2.5 million, or 2.6 percent, to 75 million at LAX with MAGLEV implementation. But each remaining passenger would see the average wait time for a landing or take-off reduced by approximately 2.7 minutes. The monetized value of these timesavings, for all remaining passengers, is on the order of $188.4 million annually. Passengers at Ontario International Airport would experience some increase in travel time delays as a result of higher passenger activity, and the resulting net benefit in travel time savings for all travelers—LAX and Ontario International Airport combined—is estimated to be approximately $182.7 million.

Table G-47

Airport Congestion Delay Savings - 2020
Los Angeles International and Ontario Airports

	LAX			Ontario		
	Baseline	w/MAGLEV	Difference	Baseline	w/MAGLEV	Difference
Airline Operations Delay Savings						$70,310
Annual Aircraft Operations	$815,260	$768,490	$(46,770)	$203,810	$274,120	$0.33
Projected Delay per Operation (min.)	$11.46	$8.80	$(2.66)	$0.5	0.83	
Avg. Aircraft Operating Cost ($ per min.)						
Commercial Jet	$48.29	$48.29	-	$48.29	$48.29	-
Commuter Aircraft	$14.68	$14.68	-	$14.68	$14.68	-
Annual Cost Savings ($ Millions)			$64.56			$(2.26)
Net Savings ($ Millions)			**$62.30**			-
Passenger Travel Delay Savings						
Air Passenger (MAP -- Millions)	$94.18	$91.71	$(2.47)	$15.37	$22.18	$6.81
Projected Delay per Passenger (min.)	$11.46	$8.80	$(2.66)	$0.50	$0.83	$0.33
Passenger Value of Time ($ per min.)	$46.40	$46.40	-	$46.40	$46.40	-
Annual Travel Delay Savings ($ Millions)			$ 188.36			$(5.63)
Net Savings ($ Millions)			**$182.73**			

Source: SCAG Aviation Taskforce RTP Medium Scenario, RADAM Version 4.2 (aircraft operations and air passengers)

U. S. Dept. of Transportation, Federal Railroad Administration, High- Speed Ground Transportation for America, September 1997;
Volpe National Transportation Systems Center (projected delay model; value of time)
Parsons Transportation Group

In the early years of MAGLEV operation, when airport congestion is less and passenger diversions are less, the annual delay savings for aircraft operations and air passenger travel time would be less. In 2010, for example, MAGLEV service is projected to divert approximately 4.0 percent of operations and 1.8 percent of air passengers from LAX, and savings are reduced accordingly. In later years of MAGLEV operation, as ridership grows and airport congestion worsens, annual delay savings for aircraft operations and air passenger travel time would be greater. In 2040, MAGLEV service is projected to divert approximately 7.0 percent of operations and 3.2 percent of air passengers from LAX. Benefits to airlines and passengers increase accordingly.

Since there is considerable debate about both the ultimate capacity of airports such as LAX and the maximum operating delay that would be tolerated (before major capital improvements or changes in airline operating procedures would occur), the extrapolation of delay savings into the future is uncertain. Delay becomes extreme at high operations levels, and the monetized value of potential delay savings probably becomes too optimistic. To avoid truly unreasonable scenarios on future delay savings, both passenger volumes and aircraft diversions were capped at LAX. For example, annual passengers were assumed not to exceed 125 million, with or without MAGLEV. This figure may be debatable and not realistic without major capital expansion. It is in line, however, with the maximum volumes assumed in the *HSGT Stud*y.

One significant benefit of MAGLEV for air travel in the Los Angeles metropolitan area that is not quantified in this analysis is the improved accessibility and efficiency of all airports. Not only would LAX benefit from a MAGLEV connection to Ontario International Airport but also, according to SCAG's Aviation Task Force studies, the entire regional airport network would experience an overall increase in air traffic once MAGLEV service matures. The RADAM model projections for 2020 traffic across the region's 12 airports show total regional air passengers increasing by approximately 5 million (from 157.4 MPA to 162.2 MPA) with MAGLEV implementation. This indicates that there is latent air travel demand realized only when the regional airport network becomes more efficient, through diversion of flights to less congested locations and improved ground access.

Highway Congestion Delay Savings

Just as MAGLEV will divert air passengers from congested facilities to those that are less congested, it is also expected to divert automobile and truck traffic from congested roadway facilities. In theory, less congestion leads to improved operating speeds for remaining roadway users. Faster travel speeds equate to shorter overall travel times, and these time savings can be monetized by multiplying by the value of time to the average motor vehicle occupant.

Travel projections indicate that with MAGLEV deployment, motor vehicle miles of travel (VMT) will decline within the metropolitan area. The decline in VMT has significant benefits for both energy use and motor vehicle emissions. These are quantified in subsequent sections. However, because of the nature of travel markets and travel behavior in the region, this reduction in VMT does not translate directly into projections of less peak period traffic on the major study area roadways, specifically the freeways and expressways paralleling the project alignment. This is actually not an atypical finding of travel model forecasts for heavily congested roadway networks in growing urban areas. The major transportation facilities in metropolitan Los Angeles, for example, are typically currently at capacity during peak periods as well as during many other hours of the day. In the future, overall network congestion is only expected to become more severe, even with ongoing implementation of improvements in the adopted RTP.

Although a significant number of auto and truck trips in the heavily congested roadway network will divert to MAGLEV, SCAG forecasts indicate that traffic from other congested facilities—local streets and arterials, for instance—diverts to the freeway and expressway system when capacity becomes available. The result is little or no change in freeway and expressway volumes, with and without MAGLEV.

Nonetheless, MAGLEV can still be argued to have an implicit, or indirect, beneficial impact on network traffic. Forecasts of 2020 MAGLEV link volumes indicate that peak hour, peak direction ridership ranges from 1,100 in the segment between Riverside and the March Inland Port to 3,100 in the segment between Union Station and the City of Industry. Approximately 70 percent to 80 percent of these riders formerly traveled by automobile. Using very conservative assumptions about average vehicle occupancies and mode shifts, MAGLEV will remove over 500 peak hour, peak direction vehicles in the first, eastern segment of the corridor and over 1,000 peak hour, peak direction vehicles per hour in the congested middle segment of the corridor. Through this diversion, MAGLEV effectively opens up capacity on major freeways and therefore it also reduces congestion on local streets, when remaining traffic there diverts to the freeway corridor.

An alternative method to conventional travel model forecasting was used to quantity and monetizes these indirect benefits on highway congestion. The highway congestion delay savings model framework developed for the *HSGT Study* was adapted to estimate the potential benefits of MAGLEV, with the assumption that travel time savings can be represented by the change in average speed along parallel freeways with a diversion of traffic to MAGLEV. A further assumption for analysis purposes is no re-diversion of local and other motor vehicle traffic back to the freeway.

The *HSGT Study* model essentially evaluates the change in vehicle-to-capacity ratios, and their effect on average freeway travel speed, for peak hour traffic volumes with and with MAGLEV. The change in speed can be equated to a change in travel time over the roadway segment analyzed. MAGLEV traffic diversion will reduce the V/C ratio and thereby increase the average travel speed for the remaining users of the roadway. This benefit is monetized by applying a value of travel time for highway users to the incremental difference in travel times with and without MAGLEV. Although the model provides essentially a peak hour estimate of timesavings, the benefits are applied to all highway users during congested peak periods.

Prior studies have shown that in extremely congested traffic environments like metropolitan Los Angeles, very high estimates of travel time benefits may result from the highway delay savings model. As with most models, the highway savings model is sensitive to baseline assumptions; it does not include feedback mechanisms to adjust parameters when future conditions change. In order to provide a conservative estimate of potential highway congestion delays savings, several conservation adjustments were made to base input factors and conservative assumptions were made about future traffic conditions, as follows:

- Freeway lane capacities of 2,150 vehicle per hour (2,200 maximum service flow rate adjusted for a four percent heavy vehicle and two percent recreational vehicle traffic mix).

- Peak hour factor of 7 percent; directional split of 55 percent to the peak direction.

- Total of 6 peak traffic hours each weekday; 250 weekday equivalents in a year.

- Average vehicle occupancies of 1.5 individuals.

- Average value of travel time of $12.93 per hour.

ü No significant growth in freeway baseline volumes from current levels.

Furthermore, congestion relief was assumed to only be along the roadway segments directly paralleling MAGLEV between stations. The travel distance over which congestion benefits were monetized was limited to approximately that of the interstation distances defining the three MAGLEV segments analyzed.

The MAGLEV segments analyzed were those with the highest level of traffic congestion on parallel freeways:

ü LAX to Union Station

ü Union Station to City of Industry

ü City of Industry to Ontario International Airport

No congestion delay savings were estimated for highway corridors east of Ontario, which although congested, are areas where MAGLEV traffic diversion is lowest.

Table G-48 is a summary of the estimated highway congestion delay savings in 2020 that can be conservatively attributed to MAGLEV. The corridor segments identify which freeways are primarily affected by MAGLEV traffic diversion and for which travel timesavings are based.

The major delay savings occur in the corridor segment between downtown Los Angeles and the City of Industry. Annualized, delay savings to remaining highway users are on the order of $43.7 million in 2020. The combined delay savings for the three corridor segments are on the order of $64.6 million. This steadily increases with MAGLEV ridership growth, and continuing diversion of motor vehicle traffic, in the years beyond the 2020 horizon. The savings are less in the period 2010 to 2020, as ridership expands. As noted, the analysis assumes no background growth in freeway traffic that would magnify congestion and any delay savings from MAGLEV diversion.

Table G-48

Highway Congestion Delay
LAX to Ontario Line Segments

	LAX - Union Station (I-105 & I-110)			Union Station - Industry (I-10 & Rte. 60)			Industry - Ontario (I-10 & Rte. 60)		
	Baseline	W/MAGLEV	Difference	Baseline	W/MAGLEV	Difference	Baseline	W/MAGLEV	Difference
Daily MAGLEV Trips on Line Segment	-	25,100	25,100	-	41,600	41,600	-	29,400	29,400
Peak Hour, Peak Direction MAGLEV Trips	-	1,900	1,900	-	3,100	3,100	-	2,200	2,200
Segment in length in miles	*16*	*16*	-	*26*	*26*	-	*15*	*15*	-
Peak Hour, Peak Direction Freeway Traffic	8,950	8,500	(450)	18,700	17,900	(800)	15,000	14,500	(500)
Peak Hour, Peak Direction Vehicle Passengers	13,400	12,700	(700)	28,000	26,900	(1100)	22,500	21,700	(800)
Vehicle Travel Time (Hrs. per Veh. Pass.)	0.54	0.48	(0.05)	0.96	0.87	(0.08)	0.36	0.35	(0.02)
Daily Travel Times Savings (6-Hour Peak)[1]									
Annual Travel Delay Savings ($ Millions)[2]			**$13.40**			**$43.70**			**$7.60**
Grand Total Savings ($ Millions)									**$64.60**

[1] Value of travel time for auto travelers estimated at $12.93 per hour.

[2] Daily value annualized using a factor of 250.

Source: SCAG ridership forecasts for Candidate Project

U.S. Dept. of Transportation, Federal Railroad Administration, High- Speed Ground Transportation for America, September

Parsons Transportation Group

Air Quality Benefits

Regional project related benefits were determined by analyzing the net change in regional criteria and precursor pollutants and CO_2 emissions resulting from the project relative to the no build scenario. The basic methodology for estimating the net change in air pollutant emissions resulting from operation of the proposed project is to subtract the emissions which will *not* be created and released due to the reduction in use of passenger and commercial vehicles from the increase in emissions required to produce the additional electrical power. The reduction in vehicle miles traveled for passenger vehicles and trucks hauling freight are listed on Table G-49. A portion of the VMT are assumed to occur during peak hours and off-peak hours.

Table G-50 summarizes the reductions of emissions due to decreases in VMT. Table G-51 summarizes emissions from regional power plants due to the increased power requirements of the project. Finally, Table G-52 summarizes the net change in criteria pollutant and precursor emissions and CO_2 emissions from the proposed project. All results are for project forecast years of 2020.

Table G-49

Annual Vehicle Miles Traveled (VMT)	
Passenger Vehicles – Peak	239,811,984
Passenger vehicles – Off-Peak	159,874,656
Trucks – Peak	10,000,000

Table G-50

Decreases in Emissions due to VMT Reductions in the Year 2020	
Pollutant	Tons/Year
TOG	-49.5
CO	-1001
NO_X	-181.6
CO_2	-125,877
PM_{10}	-12.2

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Table G-51

Increases in Emissions due to MAGLEV Power Requirements in 2020	
Pollutant	**Tons/Year**
TOG	1.8
CO	12.7
NO_X	23.9
CO_2	33,931
PM_{10}	76.1

Table G-52

Net Changes in Emissions Resulting From the Proposed MAGLEV Project	
Pollutant	**Tons/Year**
TOG	-44.1
CO	-988
NO_X	-157.7
CO_2	-91,946
PM_{10}	63.9

As shown on Table G-52, the production of the required power for the operation of the proposed MAGLEV train would result in emissions of TOG, CO, NOx, and Co_2, which are predicted to be lower (represented by a negative number) than those from the equivalent vehicular exhaust. Therefore, the implementation of the proposed project would result in a decrease in emissions of these pollutants, a significant net environmental benefit. This is especially beneficial for o_3 and CO levels for which all or parts of the South Coast Air Basin is designated non-attainment and is under federal mandate to reduce these emissions. TOG include volatile organic compounds which are precursors to o3.

The production of power for the operation of the proposed MAGLEV system is predicted to result in slightly higher emissions of P_{M10} than would be "saved" from the no build alternative for the year 2020. The South Coast Air Basin is in severe non-attainment of the P_{M10} federal and state standards. However, the increase in emissions is only 0.038 percent of the 1996 South Coast Air Basin P_{M10} emission inventory. In addition, approximately 91 percent of the added P_{M10} emissions shown in Table 9-5? is from coal burning power plants which are located outside of the Basin. Thus, operation of the MAGLEV system would increase P_{M10} emissions from power plants by only 6.8 tons per year within the Basin. Since the project is estimated to remove 12.2 tons per year from vehicles, the project would decrease overall P_{M10} emissions within the Basin. Therefore, the project would result in a net environmental benefit with respect to P_{M10} for the Los Angeles Basin.

Emissions Savings

Another direct and significant benefit of reduced auto trips with the introduction of MAGLEV is a decrease in emissions of pollutants. The decrease in emissions is projected to be directly proportional to the reduction in vehicle miles of travel (VMT) attributed to the implementation of MAGLEV. (A slight change in travel behavior and a change in travel speeds under the “with MAGLEV service” condition could have an effect on emissions rates, but this is not considered a significant and measurable effect). VMT with and without MAGLEV is another output of the SCAG transportation model. The reduction in VMT was multiplied by an emissions factor for several critical pollutants, including those for which the South Coast Air Basin is in non-attainment with respect to federal EPA-established National Ambient Air Quality Standards (NAAQS), and two other pollutants with known environmental impacts. This yields an estimate of annual tons in reduced emissions of each pollutant, which was then multiplied by a cost per ton as follows:

Nonattainment Pollutants (Value per Ton)

ü	Carbon Monoxide (CO)	–	$11,055
ü	Reactive Organic Gases (ROG)	–	$22,470
ü	Particulate Matter (P_{M10})	–	$ 6,775
ü	Other pollutants:		
	• Carbon Dioxide (C_{O2})	–	$ 18
	• Sulfur Oxides (S_{Ox})	--	$ 713
	• Nitrogen Oxides (N_{Ox})	–	$ 31,385

Note: ROGs are $_{O}3$, or ozone, precursors. The Los Angeles basin exceeds the national standard for $_{O}3$.

These dollar values were derived by escalating the values cited in the *HSGT Study* to current dollars using the change in CPI for the period 1993 to 2000. The unit costs assigned non-attainment pollutants reflect the estimated current cost to control emissions of each pollutant in the Los Angeles area. The unit cost per ton for C_{O2} reflects its “impact on the global greenhouse effect” *(HSGT Stud*y, page 6-9). While the unit cost for S_{Ox} reflects the “value of emissions allowances traded on the commodities market.” *(HSGT Study,* page 6–9) The region is in attainment with respect to air quality standards for N_{Ox} and, therefore, no emissions savings benefit is assumed for this pollutant.

This benefits calculation is similar to that adopted in the *HSGT Study* but does not assume (or calculate) emissions savings based on changes in mode and energy use associated with the mode. As stated previously, although the distribution of landings and takeoffs in the region would shift, air travel volumes are not assumed to change substantially. MAGLEV will also divert transit trips from other modes, such as Metrolink commuter rail, Metrobus and Metro Rail, but these diversions are small relative to the number of auto and truck trips diverted. Therefore, only automobile and truck travel emissions impacts are accounted for in this analysis.

Consistent with the procedures developed in the *HSGT Stud*y, missions savings benefits were not taken for those pollutants for which the Los Angeles area is currently in attainment with respect to the NAAQS. These include NO_X. Although control of such pollutants is important and their continued emissions have a high cost, the emissions savings attributable to MAGLEV is assigned no monetary value.

The assumptions and methodology for calculating emissions are described in subsection 5.1, Air Quality, of the MAGLEV Environmental Assessment.

Table G-53 summarizes the projected emissions savings for a representative year of MAGLEV operation. In 2020, for example, the net reduction in CO, ROG, PM_{10} and CO_2 emissions resulting from a decrease in study area VMT due to MAGLEV service is valued at $12.4 million.

For benefit-cost comparisons that take into account very long-range perspectives (e.g., to 2045 as is done in this study), it is extremely difficult to estimate the trends in emissions savings. For instance, although the Los Angeles metropolitan area is projected to continue growing in population and employment well beyond 2020, with a resulting increase in traffic and VMT, new technologies and modes of personal travel are likely to appear on the horizon. Very clean-emissions vehicles will become prominent in the vehicle fleet. To be conservative in evaluating emissions savings, the analysis assumes no significant increase in such savings after the year 2020, and in fact, assumes a zero benefit from reduction of non-attainment pollutants after the year 2030. This assumes new technology will allow the region to meet whatever NAAQS are in effect at that time.

Table G-53

Emissions Savings: Value of Reduced Air Pollution Year 2020, Low Ridership Scenario			
Pollutant	Net Decrease in Emissions (Tons/ Year)*	Value Per Ton ($)	Total Annual Savings ($ Millions)
CO	988.0	11,055	10.92
ROG[b]	44.1	22,470	0.99
PM_{10}	63.9	6,775	0.43
CO_2	91,946.0	18	1.64
NO_x[c]	*157.7*	*31,385*	*4.95*
SO_x	N/A	713	-
TOTAL	**93,042.0**		**13.99**

a Decrease in emissions due to VMT reductions as a result of MAGLEV service less the increase in emissions due to MAGLEV power requirements.
b Reactive Organic Gases, which are ozone precursors. Emissions analysis was based upon change in Total Organic Gases, which are very similar.
c Area is in attainment with respect to national standard; savings are not included in benefits total. Source: Parsons Engineering Science, Inc. and Parsons Transportation Group Inc., USDOT, FRA, (High Speed Ground Transportation for America," September 1997)

Summary of Total Benefits

The above components—revenues, users' consumer surplus, airport congestion savings, highway congestion savings, and emissions savings—represent the total benefits of MAGLEV deployment from a benefit-cost perspective. The benefits are monetizable, independent, and, from a national perspective, not a transfer of economic benefits from one area to another.

Combined, the estimated benefits amount to $998.9 million in 2020. The major benefits of the project are fare revenue and users' consumer surplus; these figures, when combined, represent around 60 percent of the year 2020 total benefits. Table G-54 is a summary of the total benefits of the project.

For benefit-cost comparisons, total benefits are calculated from 2003 (when significant project expenditures begin) to the year 2045 and discounted to 2003 using a specified discount rate of 7.0 percent. The net present value of MAGLEV project benefits over this timeframe is on the order of $7,702.8 million. Direct operating revenues from all sources amount to approximately 37 percent of the present value of total project benefits.

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MAGLEV project costs are similarly estimated and discounted. Section 7provides a summary of the project level benefit-cost comparison.

Table G-54

Summary of Project Total Benefits
(Year 2000 Dollars)

Year	Fares	Consession & Joint Dev't	Parking	Freight	Customer Surplus	Airport Congestion Savings-Operations	Airport Congestion Savings-Passengers	Highway Congestion Savings	Vehicle Emissions Savings	TOTAL REVENUES & BENFITS
2010	$ 217.1	$ 23.6	$ 4.2	$ 4.2	$ 217.1	$ 40.3	$ 96.8	$ 46.7	$ 9.8	$ 659.9
2020	$ 310.0	$ 41.6	$ 7.6	$ 6.2	$ 310.0	$ 62.3	$ 182.7	$ 64.6	$ 14.0	$ 999.0
2030	$ 342.9	$ 51.6	$ 13.6	$ 6.8	$ 342.9	$ 76.2	$ 208.6	$ 70.7	$ 15.5	$ 1,129.1
2045	$ 398.9	$ 74.5	$ 32.6	$ 7.9	$ 398.9	$ 102.9	$ 255.0	$ 80.6	$ -	$ 1,351.5
NVP 2003 {@7%}	$ 2,417.0	$ 337.6	$ 79.1	$ 50.0	$ 2,417.0	$ 492.5	$ 1,326.4	$ 495.6	$ 87.5	$ 7,702.8

Source: Parsons Transportation Group

Additional Beneficial Impacts of the California Project

The California Project will generate a number of other benefits for the study area and region. Under the FRA guidelines, as noted, these benefits are primarily local or duplicative of other benefits and therefore are not included as true benefits in the benefit-cost comparison. These local effects of a transportation investment are designated impacts or localized benefits.

Nevertheless, many of these local effects are quite important, especially with regard to any decision as to what major transportation investments should be made in the region and where these investments ought to occur. Some of these effects potentially represent the most important advantages of MAGLEV over other investment options. For example, the economic and land use impacts of MAGLEV are very important and have great potential to alter future development patterns in the project’s corridor.

The additional effects of MAGLEV fall into three categories: other local transportation benefits, economic development impacts, and environmental and energy impacts. Where possible, the effects are quantified or even monetized to obtain a sense of their overall magnitude. Otherwise, a qualitative discussion of the project’s positive or negative effect on the component is provided.

Local Transportation Benefits

Airport Investment Deferrals

MAGLEV will connect three airports in the corridor, allowing air passengers and air carriers to shift demand from congested such as LAX, to less congested locations such as Ontario Airport and possibly March Inland Port. The discussion under airport congestion delay savings quantified the benefits to air passengers and air carriers alike of reduced flight delays when operations—takeoffs and landings—can be shifted. In both cases assigning a value to the time-saved money versus the benefits.

An additional benefit of reducing congestion at a facility like LAX, or of slowing the rate of air passenger growth leading to increased congestion, is that facility improvements can be reduced or deferred. Since investment dollars could then be spent on alternative, more pressing concerns with greater economic returns, this is a real benefit. Construction of new runways or taxiways, expansion of terminals, and provision of onsite passenger transportation services are major capital items with high price tags under consideration at many commercial airports.

The effect of MAGLEV on capital expansion requirements can be monetized by calculating the value of capacity improvements needed to accommodate passenger and air traffic volumes in the absence of MAGLEV passenger diversions. For example, in the case of LAX, current planning has identified the need for $8 billion to $10 billion in infrastructure improvements to meet growing air travel demand between now and 2020. If the improvements are reduced, or scaled back, the value is the difference in the capital costs of the two improvement options; if the improvement can be deferred, the value is the difference in the discounted value in today's dollars of an investment made later rather than sooner.

The $8 billion to $10 billion of planned improvements at LAX is not for reducing delays. It is to accommodate growth in demand. If the improvements are made, delays will increase-not decrease. The cost of infrastructure to accommodate the same increased demand (or portion thereof) at Ontario International Airport is less than at LAX. Thus there is an additional cost avoided that is not reflected in reduced delay savings. This avoided cost is in the range of $2 billion to $4 billion.

Because the value of reduced or delayed capital improvements is arguably measuring the same basic benefit as congestion delay savings, the former are not included in the total benefits calculations. This analysis has not attempted to quantify the level of improvements that could be reduced or delayed at LAX with MAGLEV deployment.

Highway Investment Deferrals

From a total benefits perspective, the effect of MAGLEV deployment on highway users and the highway system has been monetized by estimating the value of travel time saved on major roadways in the study corridor as a result of diversion of auto trips to a new mode. Another measure of MAGLEV's positive effects on the highway mode is the ability to defer roadway construction into the future due to slower growth in VMT. Initially, with trips diverted to MAGLEV there will be less overall demand for travel on study corridor roadways. As the system matures and ridership grows, the diversion of auto trips is then expected to slow the rate of growth in vehicle trips—and VMT—over the life of the project.

The costs saved or deferred can be measured in terms of lane-miles that would otherwise be used by MAGLEV riders and by assigning a typical construction unit cost. In the Los Angeles area, where roadway right-of-way is limited and the costs of urban road construction are high, these savings can be substantial.

Similar to the case for airport investment deferrals, highway infrastructure savings are another measure of the same phenomenon as highway congestion delay savings so they are excluded from the totals benefits assessment. The analysis has not attempted to estimate the value of road construction deferred as a result of implementing MAGLEV service.

Commuter Rail Travel Efficiency Benefits

MAGLEV and commuter rail service modes are considered complementary rather than competing. There may be limited switching between the two services by some users in the corridors where the services are in close proximity. SCAG model forecasts for 2020 show Metrolink daily ridership declining along the Riverside Line, which connects downtown Riverside, Pomona, Industry and downtown Los Angeles, when MAGLEV service is also provided in the corridor.

In most instances, however, MAGLEV is expected to generate an overall increase in commuter rail use, and vice versa, through the overall enhancement of transit travel options. The same 2020 SCAG forecasts show an overall increase in Metrolink daily system ridership with MAGLEV.

Because MAGLEV will operate along a separate guideway, few direct benefits for commuter rail operations are anticipated. Direct benefits will result from increasing the number of shared grade separations, improving trackwork to support higher speed operations, and related improvements in common rail corridors. Further studies are required to determine the potential to combine MAGLEV and Metrolink improvements.

Indirectly, the benefits to commuter rail operations will arise through the development of an expanded network of rail transit infrastructure connecting more and more points of interest in the region. By increasing the number of transit modal options and the geographical and temporal coverage of transit, MAGLEV will make other modes more attractive and generate additional ridership on complementary modes.

Commuter rail will serve as a collector-distributor service to MAGLEV as well as retain its strong central city commute function. Commuter rail provides another mode of access to and egress from MAGLEV at common or neighboring stations.

These synergistic effects increase with the continuing development of both systems and expansions in service levels. They have not been quantified (or monetized) at this time. It would be possible to assign some measure of effect by looking at mode splits and overall ridership levels on each service in a more detailed ridership forecasting process.

Transportation Safety Improvements

The diversion of trips to MAGLEV will have a beneficial effect on travel safety, primarily for auto and truck travel, because MAGLEV is expected to inherently be a very safe travel mode, substantially safer than private motor vehicle travel on the roadway system within the study area.

Caltrans publishes data on accident rates for each type of state facility, from two-lane roadways to multi-lane freeways. These rates can be applied to the reduction in vehicle miles of travel (VMT) that is projected to result when automobile and truck trips shift to MAGLEV. This yields an estimate of the number of accidents avoided on roadways when MAGLEV service is operational. MAGLEV itself, although a grade-separated mode with a high level of safety by design, would also be expected to experience accidents from time-to-time. Using relevant accident rates for a similar mode, an estimate of the number of accidents incurred on MAGLEV can be made and subtracted from the estimate of roadway accidents avoided to give a net change in total annual accidents.

Roadway accidents are recorded for three basic types of accidents: property damage only, non-fatal injury accidents, and fatalities.

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Fatalities are probably the most important accident type from a public policy perspective because loss of life has a number of

Table G-55

Safety Benefits of Reduced Roadway Travel
Projected for 2020 (Calculated in 2000 Dollar Values)

Mode/Accident Type	Accident Rate	Unit	No. of Units[a]	Projected Change in Accidents	Monetary Value[b]
Suburban State Roadways [c]					
Fatalities	0.14	per 100,000,000 Veh. Mi.	(4.1)	(1.7)	($4,400,800)
Bodily Injury	0.49	per 1,000,000 Veh. Mi.	(409.7)	(200.7)	
Property Damage Only	0.80	per 1,000,000 Veh. Mi.	(409.7)	(327.7)	
MAGLEV					
Fatalities	0.01	per 100,000,000 Pass. Mi.	7.0	1.0	147,700
Total (Fatalities Only)				**(1.6)**	**($4,253,100)**

[a] Units in terms of hundred million or million vehicle miles (HMVMT; MVMT) or million passenger miles (MPM). Number in parenthesis indicates a decrease in number of vehicle miles due to MAGLEV. A positive value indicates a increase in passenger miles on MAGLEV.

[b] Monetary value of loss of life (Federal Aviation Administration) is $2.62 million.

[c] Total accident rate for urban areas in Caltrans District 07 in 1998.

Source: Accident data on California Highways (1998). State of California Business, Transportation, and Housing Agency Department of Transportation, Traffic Operations Program, 1999

Methodology Report for Task Order No. 102: Estimating External Costs and Benefits for High-Speed Ground Transportation. De Leuw, Cather & Company, February 1995

Parsons Transportation Group

associated long-term socio-economic impacts. Private or other insurance generally covers the costs of property damage and most injuries, minimizing the social costs of these accident types. However, fatalities generally have a permanent cost in terms of lost earnings, in addition to the intangible loss of companionship for which there can be no full compensation.

The transportation safety benefits of a net reduction in fatalities can be monetized using guidance from the Methodology Report for the *HSGT Stud*y. In that analysis, the monetary value of life as estimated by the FAA was determined to provide a conservative, reasonable figure for benefit-cost comparisons. Table G-55 summarizes the transportation safety benefits calculation for MAGLEV. Accident rates for roadway travel are based upon recorded rates per million or hundred million miles of vehicle travel on all state urban roadways types in Caltrans District 07, which includes the study area. All roadway types were used since it is likely that MAGLEV will divert motor vehicle travel not just from freeways but from congested arterials as well. Accident rates for MAGLEV are based upon experience in Europe on high-speed rail corridors.

MAGLEV is projected to result in a net reduction of approximately 1.5 fatalities annually on transportation systems in the study area, given 2020 conditions. The annual monetary benefit is a savings of approximately $4.3 million. As the table shows, the reduction in roadway VMT attributable to MAGLEV will also result in a significant reduction in bodily injury and property damage accidents on roadways, on the order of 200 and 325 incidents, respectively, in 2020.

Ridership and Revenue for Candidate Alignments

Alignment selection is an iterative process, dependent on many variables. Based on an initial engineering assessment, and in keeping with right-of-way limitations, six to nine possible alignments were considered between each major station pair. Candidate alignments were then selected for ridership modeling. Finally, the financing capabilities of candidate alignments were analyzed.

Due to the fact the Environmental Evaluation was to be completed by February 29 of this year, a candidate alignment was selected based on initial engineering factors, absent of ridership and financing capability. This alignment will be identified throughout the Project Description as the EA (Environmental Analysis) alignment. Once ridership and financing were added to the equation, alignment alternatives were tested for optimal performance. Variations in station location and right-of-way of the EA alignment produced profitable options that can be analyzed further during the NEPA/CEQA environmental analysis phase.

The alignment that performs best under financing and ridership models is presented in the MAGLEV Project Description as the Constrainable Alignment.

In *Segment On*e, two highly likely alternatives connect LAX to Union Station. By traveling north on I–405 from LAX and then east to Union Station on I–10 and adding a West Side station, passenger trips increase in the ridership model. The other alignment connects LAX and Union Station via the MTA owned Harbor Subdivision rail line. Capital costs, service parameters, and ridership are comparable and benefits and community impacts need further review in the next phase. Both options can produce a project capable of financing.

Segment Two connects Union Station and Ontario via the UP West line and I–10. One alternative stays on the rail line with a potential station in City of Industry. The other viable alternative would cross over I–10 with a potential station in West Covina. Ridership and costs differentials need further evaluation, however either alignment can be financed within the parameters of the financial forecast.

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Segment Three for the Constrainable Alignment follows I–10 and includes a station stop in San Bernardino, then continues south to Riverside along I-215 with a station near SR-60. In the EA alignment is I–15 S to SR 60 to I–215 to March Inland Port (formerly March Air Reserve Base).

As shown in Table G-56, the Constrainable Alignment is projected to carry approximately 75,000 daily riders in year 2020. Research indicates that higher ridership is possible through fare optimization. The average fare has been calculated at approximately $10.50 depending on distance traveled.

Table G-57 shows annual passenger revenues for the Constrainable Alignment.

As shown, the Constrainable Alignment would generate approximately $324 million annually in passenger revenues in 2020. Gross revenue for the Constrainable Alignment is $390 million in year 2020. The Constrainable Alignment capital cost is estimated to be $4.8 billion.

Table G-56

Optimal Alignment Characteristics in Year 2020 (Year 2000 dollars)		
Daily Ridership Range	**Gross Revenue**	**Operation & Maintenance**
75,000 – 90,000	$390 million	$ 80 million

Station-to-Station Daily Passenger Boardings for MAGLEV Alternatives

ALTERNATIVE 2mhf2c-sb

San Bernardino; Mid Corridor - City Of Industry

PEAK PERIOD STATION TO STATION

	LAX	Union	Industry	Ontario	San Bernd.	Riverside	Total
LAX		4,061	752	715	313	158	5,999
Union	4,061		3,025	1,343	1,665	2,370	12,464
Industry	752	3,025		891	578	443	5,689
Ontario	715	1,343	891		854	900	4,703
San Bernd.	313	1,665	578	854		125	3,534
Riverside	158	2,370	443	900	125		3,995
Total	5,999	12,464	5,689	4,703	3,535	3,996	**36,384**

OFFPEAK PERIOD STATION TO STATION

	LAX	Union	Industry	Ontario	San Bernd.	Riverside	Total
LAX		4,387	1,213	1,602	301	270	7,774
Union	4,387		3,247	2,173	1,131	1,226	12,163
Industry	1,213	3,247		1,346	480	386	6,672
Ontario	1,602	2,173	1,346		627	887	6,635
San Bernd.	301	1,131	480	627		125	2,663
Riverside	270	1,226	386	887	125		2,894
Total	7,773	12,164	6,672	6,635	2,664	2,894	**38,801**

DAILY TOTAL STATION TO STATION

	LAX	Union	Industry	Ontario	San Bernd.	Riverside	Total
LAX		8,448	1,965	2,317	615	428	13,773
Union	8,448		6,272	3,516	2,795	3,595	24,627
Industry	1,965	6,272		2,237	1,058	829	12,361
Ontario	2,317	3,516	2,237		1,480	1,787	11,337
San Bernd.	615	2,795	1,058	1,480		250	6,198

Riverside	428	3,595	829	1,787	250		6,889
Total	13,773	24,626	12,361	11,337	6,198	6,889	**75,185**

ANNUAL TOTAL STATION TO STATION							
	LAX	Union	Industry	Ontario	San Bernd.	Riverside	Total
LAX		2,714,926	672,071	838,930	200,467	149,396	4,575,790
Union	2,714,926		2,029,915	1,196,092	856,717	1,082,391	7,880,042
Industry	672,071	2,029,915		750,688	334,660	264,043	4,051,376
Ontario	838,930	1,196,092	750,688		465,678	561,506	3,812,895
San Bernd.	200,467	856,717	334,660	465,678		77,604	1,935,126
Riverside	149,396	1,082,391	264,043	561,506	77,604		2,134,940
Total	4,575,790	7,880,041	4,051,377	3,812,894	1,935,126	2,134,940	**24,390,169**

Table G-57

Station-to-Station Daily Passenger Boardings for MAGLEV Alternatives

ALTERNATIVE 2mhf2c-sb

San Bernardino; Mid Corridor - City Of Industry

MILEAGE BETWEEN STATIONS

	LAX	Union	Industry	Ontario	San Bernd.	Riverside
LAX		15.89	41.68	56.46	72.46	76.86
Union	15.89		25.79	40.57	56.57	60.97
Industry	41.68	25.79		14.78	30.78	35.18
Ontario	56.46	40.57	14.78		16.00	20.40
San Bernardino	72.46	56.57	30.78	16.00		4.40
Riverside	76.86	60.97	35.18	20.40	4.40	

TOTAL DAILY PASSENGER MILES

	LAX	Union	Industry	Ontario	San Bernd.	Riverside	Total
LAX		134,240	81,895	130,827	44,528	32,897	424,386
Union	134,240		161,767	142,634	158,137	219,195	815,973
Industry	81,895	161,767		33,066	32,560	29,165	338,452
Ontario	130,827	142,634	33,066		23,685	36,455	366,667
San Bernd.	44,528	158,137	32,560	23,685		1,098	260,007
Riverside	32,897	219,195	29,165	36,455	1,098		318,810
Total	424,387	815,973	338,453	366,667	260,008	318,810	**2,524,295**

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ANNUAL PASSENGER MILES							
	LAX	Union	Industry	Ontario	San Bernd.	Riverside	Total
LAX		43,140,175	28,011,928	47,366,013	14,525,808	11,482,571	144,526,495
Union	43,140,175		52,351,509	48,525,464	48,464,502	65,993,406	258,475,057
Industry	28,011,928	52,351,509		11,095,165	10,300,833	9,289,015	111,048,450
Ontario	47,366,013	48,525,464	11,095,165		7,450,854	11,454,727	125,892,224
San Bernd.	14,525,808	48,464,502	10,300,833	7,450,854		$341,458	$81,083,454
Riverside	$11,482,571	$65,993,406	$9,289,015	$11,454,727	$341,458		$98,561,178
Total	144,526,495	258,475,056	111,048,450	125,892,223	81,083,455	$98,561,177	**$819,586,858**

AVERAGE PASSENGER TRIP LENGTH (IN MILES): 33.57

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Daily Passenger Revenues Annualized for 2020

For Alternative 2mhf2c-sb (Mid Corridor – City of Industry)

ALTERNATIVE 2mhf2c-sb - PEAK REVENUE

	LAX	Union	Industry	Ontario	San Bern.	Riverside	TOTAL
LAX		$7,604,406	$960,364	$162,021	$638,667	$181,092	$9,546,549
Union	$7,604,406		$5,432,881	$1,899,097	$4,095,304	$6,008,999	$25,040,687
Industry	$960,364	$5,432,881		$1,292,474	$1,183,907	$894,513	$9,764,138
Ontario	$162,021	$1,899,097	$1,292,474		$1,592,770	$1,859,067	$6,805,429
San Bern.	$638,667	$4,095,304	$1,183,907	$1,592,770		$238,425	$7,749,072
Riverside	$181,092	$6,008,999	$894,513	$1,859,067	$238,425		$9,182,096
TOTAL	$9,546,550	$25,040,687	$9,764,139	$6,805,429	$7,749,073	$9,182,096	$68,087,971

ALTERNATIVE 2mhf2c-sb - OFFPEAK REVENUE

	LAX	Union	Industry	Ontario	San Bern.	Riverside	TOTAL
LAX		$6,170,451	$1,056,994	$135,872	$294,942	$95,735	$7,753,998
Union	$6,170,451		$3,883,852	$1,791,232	$1,985,352	$1,286,459	$15,117,352
Industry	$1,056,994	$3,883,852		$1,494,927	$687,567	$471,799	$7,595,139
Ontario	$135,872	$1,791,232	$1,494,927		$937,511	$1,597,076	$5,956,618
San Bern.	$294,942	$1,985,352	$687,567	$937,511		$317,900	$4,223,272
Riverside	$95,735	$1,286,459	$471,799	$1,597,076	$317,900		$3,768,968
TOTAL	$7,753,994	$15,117,346	$7,595,139	$5,956,618	$4,223,272	$3,768,969	$44,415,347

ALTERNATIVE 2mhf2c-sb - AIR PASSENGER REVENUE

	LAX	Union	Industry	Ontario	San Bern.	Riverside	TOTAL
LAX		$14,500,776	$8,272,420	$16,489,625	$2,676,383	$2,676,383	$44,615,587
Union	$14,500,776		$12,547,037	$10,880,090	$1,729,521	$1,729,521	$41,386,945
Industry	$8,272,420	$12,547,037		$5,778,191	$2,289,054	$2,289,054	$31,175,756
Ontario	$16,489,625	$10,880,090	$5,778,191		$1,731,803	$1,731,803	$36,611,511
San Bern.	$2,676,383	$1,729,521	$2,289,054	$1,731,803		$73,000	$8,499,761
Riverside	$2,676,383	$1,729,521	$2,289,054	$1,731,803	$73,000		$8,499,761
TOTAL	$44,615,587	$41,386,945	$31,175,756	$36,611,512	$8,499,761	$8,499,761	$170,789,321

ALTERNATIVE 2mhf2c-sb - SPECIAL EVENTS REVENUE

	LAX	Union	Industry	Ontario	San Bern.	Riverside	TOTAL
LAX		$2,033,598	$0	$366,949	$174,998	$227,578	$2,803,122
Union	$2,033,598		$1,275,620	$2,226,022	$2,556,611	$3,848,699	$11,940,549
Industry	$0	$1,275,620		$317,981	$230,230	$0	$1,823,831
Ontario	$366,949	$2,226,022	$317,981		$723,445	$724,700	$4,359,096
San Bern.	$174,998	$2,556,611	$230,230	$723,445		$68,255	$3,753,538
Riverside	$227,578	$3,848,699	$0	$724,700	$68,255		$4,869,231
TOTAL	$2,803,123	$11,940,550	$1,823,831	$4,359,097	$3,753,539	$4,869,232	$29,549,367

Daily Passenger Revenues Annualized for 2020							
For Alternative 2mhf2c-sb (Mid Corridor – City of Industry)							
ALTERNATIVE 2mhf2c-sb - INDUCED REVENUE							
	LAX	Union	Industry	Ontario	San Bern.	Riverside	TOTAL
LAX		$1,201,394	$300,934	$380,268	$107,577	$74,928	$2,065,102
Union	1,201,394		$892,008	$538,473	$458,754	$589,995	$3,680,624
Industry	300,934	892,008		$318,151	$162,015	$126,972	$1,800,081
Ontario	380,268	538,473	318,151		$210,513	$254,132	$1,701,537
San Bern.	107,577	458,754	162,015	210,513		$ 32,762	$971,622
Riverside	74,928	589,995	126,972	254,132	32,762		$1,078,789
TOTAL	2,065,101	3,680,624	1,800,080	1,701,537	971,621	1,078,789	11,297,755
ALTERNATIVE 2mhf2c-sb - TOTAL REVENUE							
	LAX	Union	Industry	Ontario	San Bern.	Riverside	TOTAL
LAX		$31,510,630	$10,590,711	$17,534,735	$3,892,567	$3,255,716	$66,784,358
Union	31,510,630		$24,031,399	$17,334,913	$10,825,543	$13,463,672	$97,166,157
Industry	10,590,711	24,031,399		$9,201,724	$4,552,773	$3,782,337	$52,158,944
Ontario	17,534,735	17,334,913	9,201,724		$5,196,042	$6,166,778	$55,434,192
San Bern.	3,892,567	10,825,543	4,552,773	5,196,042		$ 730,342	$25,197,266
Riverside	3,255,716	13,463,672	3,782,337	6,166,778	730,342		$27,398,845
TOTAL	66,784,359	97,166,157	52,158,944	55,434,192	25,197,267	27,398,845	324,139,762